About This Guide

This preface discusses the objectives, audience, organization, and conventions of this network module hardware installation guide.

Objectives

This publication provides hardware installation information for Cisco network modules used in Cisco 3600 series and Cisco 2600 series modular access routers, referred to as Cisco modular routers.

This publication describes a variety of router models that are similar in functionality, but differ in the number of interfaces supported. Some information provided might not apply to your particular router model.

How to Use This Guide

This guide contains an overview of network modules and information on connecting specific network modules to your Cisco modular router. Refer to Table 1-1 in Chapter 1, “Overview of Cisco Network Modules” for a listing of network modules supported by Cisco 3600 series routers and the required release of Cisco IOS software for each module.

Refer to Table 1-2 in Chapter 1, “Overview of Cisco Network Modules” for a listing of network modules supported by Cisco 2600 series routers and the required release of Cisco IOS software for each module.

If required, see Chapter 3, “Installing Network Modules in Cisco Modular Routers” for instructions on installing a network module in your router.

Refer to the *Software Configuration Guide* (for Cisco 3600 series and Cisco 2600 series routers) for an overview of network module configuration procedures and information on configuring specific network modules.

Audience

This guide is designed for the person installing the modular router, who should be familiar with electronic circuitry and wiring practices and have experience as an electronic or electromechanical technician.

Organization

The major sections of this guide include:

Chapter	Title	Description
Chapter 1	Overview of Cisco Network Modules	Lists the network module options for Cisco 3600 series and Cisco 2600 series modular routers.
Chapter 2	Preparing to Install Network Modules	Discusses safety information, and describes the various tools and equipment required to install a network module.
Chapter 3	Installing Network Modules in Cisco Modular Routers	Includes basic installation information for installing network modules in Cisco 3600 series and Cisco 2600 series modular routers.
Chapter 4	Connecting Ethernet Network Modules to a Network	Discusses basic hardware installation information for connecting the various Ethernet network modules to a network, and describes the network module LEDs.
Chapter 5	Connecting Fast Ethernet PRI Network Modules to a Network	Discusses basic hardware installation information for connecting the Fast Ethernet Primary Rate Interface (PRI) network modules to a network, and describes the network module LEDs.
Chapter 6	Connecting Serial Network Modules to a Network	Discusses basic hardware installation information for connecting the various serial network modules to a network, and describes the network module LEDs.

Chapter	Title	Description
Chapter 7	Connecting ISDN BRI Network Modules to a Network	Discusses basic hardware installation information for connecting the various Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI) network modules to a network, and describes the network module LEDs.
Chapter 8	Connecting ISDN PRI Network Modules to a Network	Discusses basic hardware installation information for connecting the various ISDN PRI network modules to a network, and describes the network module LEDs.
Chapter 9	Connecting Voice Network Modules to a Network	Discusses basic hardware installation information for connecting the various voice network modules to a network, and describes the network module LEDs.
Chapter 10	Connecting Digital Modem Network Modules to a Network	Discusses basic hardware installation information for connecting the various digital modem network modules to a network, and describes the network module LEDs.
Chapter 11	Connecting Analog Modem Network Modules to a Network	Discusses basic hardware installation information for connecting analog modem network modules to a network, and describes the network module LEDs.
Chapter 12	Connecting ATM Network Modules to a Network	Discusses basic hardware installation information for connecting Asynchronous Transfer Mode (ATM) network modules to a network, and describes the network module LEDs.
Chapter 13	Connecting HSSI Network Modules to a Network	Discusses basic hardware installation information for connecting High-Speed Serial Interface (HSSI) network modules to a network, and describes the network module LEDs.
Chapter 14	Connecting Compression Network Modules to a Network	Discusses basic hardware installation information for connecting compression network modules to a network, and describes the network module LEDs.
Appendix A	FCC Class B Compliance	Contains the compliance statement for a Class B digital device that satisfies the specifications in part 15 of the FCC rules.

Conventions

This publication uses the following conventions to convey instructions and information:

Convention	Description
boldface font	Commands and keywords.
italic font	Variables for which you supply values.
[ ]	Keywords or arguments that appear within square brackets are optional.
{x | y | z}	A choice of required keywords appears in braces separated by vertical bars. You must select one.
`screen font`	Examples of information displayed on the screen.
`boldface screen font`	Examples of information you must enter.
< >	Nonprinting characters, for example passwords, appear in angle brackets.
[ ]	Default responses to system prompts appear in square brackets.
Note	Means *reader take note*. Notes contain helpful suggestions or references to additional information and material.
	Timesaver This symbol means *the described action saves time*. You can save time by performing the action described in the paragraph.
	Caution This symbol means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.
	Warning This warning symbol means *danger.* You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. To see translations of the warnings that appear in this publication, refer to the *Regulatory Compliance and Safety Information* document that accompanied this device.
	Waarschuwing Dit waarschuwingssymbool betekent gevaar. U verkeert in een situatie die lichamelijk letsel kan veroorzaken. Voordat u aan enige apparatuur gaat werken, dient u zich bewust te zijn van de bij elektrische schakelingen betrokken risico's en dient u op de hoogte te zijn van standaard maatregelen om ongelukken te voorkomen. Voor vertalingen van de waarschuwingen die in deze publicatie verschijnen, kunt u het document *Regulatory Compliance and Safety Information* (Informatie over naleving van veiligheids- en andere voorschriften) raadplegen dat bij dit toestel is ingesloten.

Convention	Description
	Varoitus Tämä varoitusmerkki merkitsee vaaraa. Olet tilanteessa, joka voi johtaa ruumiinvammaan. Ennen kuin työskentelet minkään laitteiston parissa, ota selvää sähkökytkentöihin liittyvistä vaaroista ja tavanomaisista onnettomuuksien ehkäisykeinoista. Tässä julkaisussa esiintyvien varoitusten käännökset löydät laitteen mukana olevasta *Regulatory Compliance and Safety Information* -kirjasesta (määräysten noudattaminen ja tietoa turvallisuudesta).
	Attention Ce symbole d'avertissement indique un danger. Vous vous trouvez dans une situation pouvant causer des blessures ou des dommages corporels. Avant de travailler sur un équipement, soyez conscient des dangers posés par les circuits électriques et familiarisez-vous avec les procédures couramment utilisées pour éviter les accidents. Pour prendre connaissance des traductions d'avertissements figurant dans cette publication, consultez le document *Regulatory Compliance and Safety Information* (Conformité aux règlements et consignes de sécurité) qui accompagne cet appareil.
	Warnung Dieses Warnsymbol bedeutet Gefahr. Sie befinden sich in einer Situation, die zu einer Körperverletzung führen könnte. Bevor Sie mit der Arbeit an irgendeinem Gerät beginnen, seien Sie sich der mit elektrischen Stromkreisen verbundenen Gefahren und der Standardpraktiken zur Vermeidung von Unfällen bewußt. Übersetzungen der in dieser Veröffentlichung enthaltenen Warnhinweise finden Sie im Dokument *Regulatory Compliance and Safety Information* (Informationen zu behördlichen Vorschriften und Sicherheit), das zusammen mit diesem Gerät geliefert wurde.
	Avvertenza Questo simbolo di avvertenza indica un pericolo. La situazione potrebbe causare infortuni alle persone. Prima di lavorare su qualsiasi apparecchiatura, occorre conoscere i pericoli relativi ai circuiti elettrici ed essere al corrente delle pratiche standard per la prevenzione di incidenti. La traduzione delle avvertenze riportate in questa pubblicazione si trova nel documento *Regulatory Compliance and Safety Information* (Conformità alle norme e informazioni sulla sicurezza) che accompagna questo dispositivo.
	Advarsel Dette varselsymbolet betyr fare. Du befinner deg i en situasjon som kan føre til personskade. Før du utfører arbeid på utstyr, må du vare oppmerksom på de faremomentene som elektriske kretser innebærer, samt gjøre deg kjent med vanlig praksis når det gjelder å unngå ulykker. Hvis du vil se oversettelser av de advarslene som finnes i denne publikasjonen, kan du se i dokumentet *Regulatory Compliance and Safety Information* (Overholdelse av forskrifter og sikkerhetsinformasjon) som ble levert med denne enheten.

Convention	Description
	Aviso Este símbolo de aviso indica perigo. Encontra-se numa situação que lhe poderá causar danos físicos. Antes de começar a trabalhar com qualquer equipamento, familiarize-se com os perigos relacionados com circuitos eléctricos, e com quaisquer práticas comuns que possam prevenir possíveis acidentes. Para ver as traduções dos avisos que constam desta publicação, consulte o documento *Regulatory Compliance and Safety Information* (Informação de Segurança e Disposições Reguladoras) que acompanha este dispositivo.
	¡Advertencia! Este símbolo de aviso significa peligro. Existe riesgo para su integridad física. Antes de manipular cualquier equipo, considerar los riesgos que entraña la corriente eléctrica y familiarizarse con los procedimientos estándar de prevención de accidentes. Para ver una traducción de las advertencias que aparecen en esta publicación, consultar el documento titulado *Regulatory Compliance and Safety Information* (Información sobre seguridad y conformidad con las disposiciones reglamentarias) que se acompaña con este dispositivo.
	Varning! Denna varningssymbol signalerar fara. Du befinner dig i en situation som kan leda till personskada. Innan du utför arbete på någon utrustning måste du vara medveten om farorna med elkretsar och känna till vanligt förfarande för att förebygga skador. Se förklaringar av de varningar som förkommer i denna publikation i dokumentet *Regulatory Compliance and Safety Information* (Efterrättelse av föreskrifter och säkerhetsinformation), vilket medföljer denna anordning.

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CHAPTER 1

Overview of Cisco Network Modules

This chapter provides an overview of Cisco network modules used in Cisco modular access routers. Cisco modular routers include:

- Cisco 3600 Series Routers on page 1-1
- Cisco 2600 Series Routers on page 1-7

Cisco 3600 Series Routers

Table 1-1 lists the network module options available for Cisco 3600 series routers with their minimum software requirements for Cisco IOS Releases 11.1, 11.2, 11.3, and 11.3 T.

Table 1-1 Network Module Options with Cisco IOS Releases for Cisco 3600 Series Routers

Network Module	Cisco Product Number	Cisco IOS Release 11.1	Cisco IOS Release 11.2	Cisco IOS Release 11.3	Cisco IOS Release 11.3 T
1-Port Ethernet	NM-1E	–	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
1-Port Fast Ethernet TX	NM-1FE-TX	–	11.2(6)P	11.3(1)	11.3(1)T
1-Port Fast Ethernet FX	NM-1FE-FX	–	–	–	11.3(1)T
1-Port Fast Ethernet 1-Port or 2-Port T1/ISDN[1] PRI[2]	NM-1FE1CT1 NM-1FE1CT1-CSU NM-1FE2CT1 NM-1FE2CT1-CSU	–	–	–	11.3(4)T

Table 1-1 Network Module Options with Cisco IOS Releases for Cisco 3600 Series Routers

Network Module	Cisco Product Number	Cisco IOS Release 11.1	Cisco IOS Release 11.2	Cisco IOS Release 11.3	Cisco IOS Release 11.3 T
1-Port Fast Ethernet 1-Port or 2-Port E1/ISDN PRI	NM-1FE1CE1B NM-1FE1CE1U NM-1FE2CE1B NM-1FE2CE1U	–	–	–	11.3(4)T
4-Port Ethernet	NM-4E	–	11.2(6)P	11.3(1)	11.3(1)T
1-Port Ethernet 2 WAN card slots	NM-1E2W	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
2-Port Ethernet 2 WAN card slots	NM-2E2W	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
1-Port Ethernet 1-Port Token Ring 2 WAN card slots	NM-1E1R2W	11.1(8)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
4-Port Serial	NM-4T	–	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
4-Port/8-Port Asynchronous/ Synchronous Serial	NM-4A/S NM-8A/S	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
16-Port/32-Port Asynchronous Serial	NM-16A NM-32A	–	11.2(7a)P	11.3(1)	11.3(1)T
4-Port/8-Port ISDN BRI[3] S/T[4]	NM-4B-S/T NM-8B-S/T	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
4-Port/8-Port ISDN BRI[5] with NT1[6]	NM-4B-U NM-8B-U	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T

Table 1-1 Network Module Options with Cisco IOS Releases for Cisco 3600 Series Routers

Network Module	Cisco Product Number	Cisco IOS Release 11.1	Cisco IOS Release 11.2	Cisco IOS Release 11.3	Cisco IOS Release 11.3 T
1-Port/2-Port Channelized T1/ISDN PRI	NM-1CT1 NM-2CT1	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
1-Port/2-Port Channelized T1/ISDN PRI with CSU[7]	NM-1CT1-CSU NM-2CT1-CSU	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
1-Port/2Port Channelized E1/ISDN PRI Unbalanced	NM-1CE1U NM-2CE1U	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
1-Port/2-Port Channelized E1/ISDN PRI Balanced	NM-1CE1B NM-2CE1B	11.1(7)AA	11.2(4)XA, 11.2(5)P	11.3(1)	11.3(1)T
1-Port/2-Port Voice	NM-1V NM-2V	–	–	–	11.3(1)T
6-Port/12-Port/18-Port/ 24-Port/30-Port Digital Modem	NM-6DM NM-12DM NM-18DM NM-24DM NM-30DM	–	11.2(9)XA 11.2(10)P	–	11.3(2)T
8-Port and 16-Port Analog Modem	NM-8AM NM-16AM	–	–	–	11.3(4)T
1-Port ATM[8]-25	NM-1ATM-25	–	–	–	11.3(3a)T

Table 1-1 Network Module Options with Cisco IOS Releases for Cisco 3600 Series Routers

Network Module	Cisco Product Number	Cisco IOS Release 11.1	Cisco IOS Release 11.2	Cisco IOS Release 11.3	Cisco IOS Release 11.3 T
1-Port HSSI[9]	NM-1HSSI	–	–	–	11.3(3)T
Compression	NM-COMPR	–	11.2(7a)P	11.3(1)	11.3(1)T

1 ISDN = Integrated Services Digital Network.
2 PRI = Primary Rate Interface.
3 BRI = Basic Rate Interface.
4 The BRI S/T module requires an external NT1.
5 The BRI U module does not require an external NT1.
6 NT1 = Network Termination 1.
7 CSU = channel service unit.
8 ATM = Asynchronous Transfer Mode.
9 HSSI = High-Speed Serial Interface.

Cisco 3600 Series Interface Numbering

Each individual network interface on a Cisco 3600 series router is identified by a slot number and a unit number.

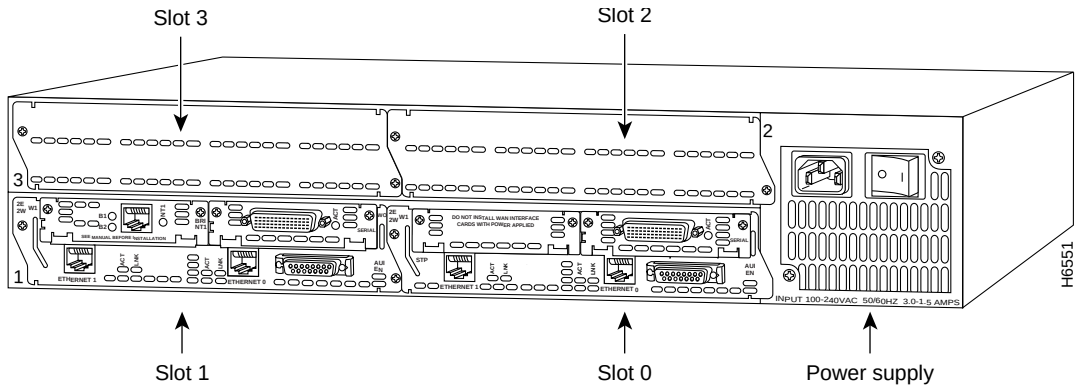
Slot Numbering

The Cisco 3600 series router chassis contains two or four slots in which you can install modules. You can install any module into any available slot in the chassis.

As shown in Figure 1-1, the slots are numbered from 0 to 3, as follows:

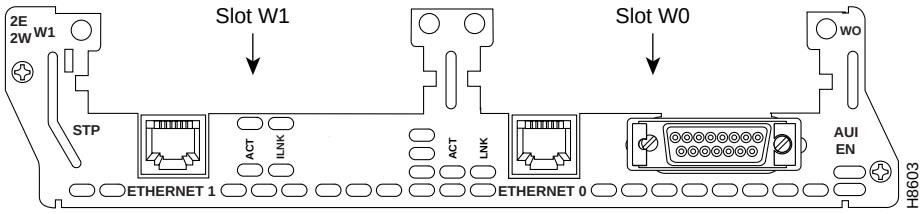
- Slot 0 is at the bottom right (as viewed from the rear of the chassis), near the power supply.
- Slot 1 is at the bottom left.
- Slot 2 is at the top right, above slot 0.
- Slot 3 is at the top left, above slot 1.

Figure 1-1 Cisco 3600 Series Module Card Slots



Some modules have two small slots, labeled W0 and W1, for WAN interface cards. Figure 1-2 shows the W0 and W1 slots of the 2 Ethernet 2 WAN card slot (2E 2-slot) module. You can install WAN interface cards into the small module slots (W0 and W1). Serial WAN interface cards can be installed into either slot, W0 or W1.

Figure 1-2 WAN Interface Card Slots

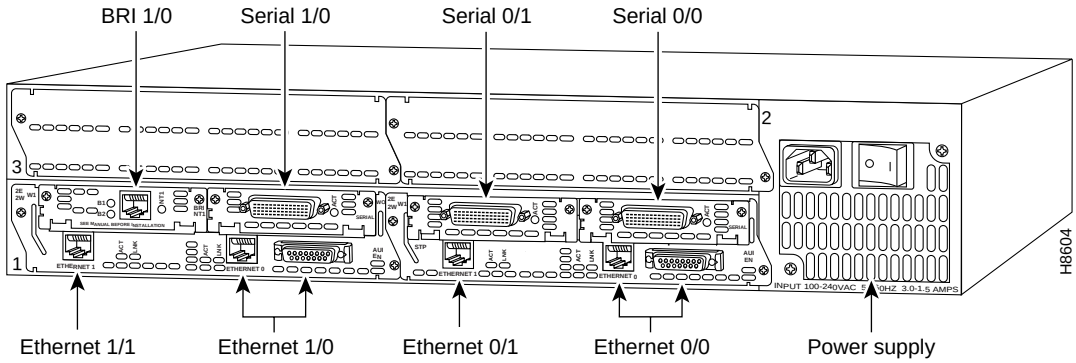


Unit Numbering

Cisco 3600 series routers unit numbers identify the interfaces on the modules and WAN interface cards installed in the router. Unit numbers begin at 0 for each interface type, and continue from right to left and (if necessary) from bottom to top. Modules and WAN interface cards are identified by interface type, slot number, followed by a forward slash (/), and then the unit number; for example, Ethernet 0/0.

Figure 1-3 shows a router with a 2E 2-slot module in slots 0 and 1. Two serial WAN interface cards are installed in the module in slot 0. One serial and one ISDN BRI WAN interface card are installed in the module in slot 1.

Figure 1-3 Cisco 3600 Series Unit Numbers



As shown in Figure 1-3, the unit numbers are as follows:

- Slot 0, Ethernet interface 0, referred to as Ethernet 0/0
- Slot 0, Ethernet interface 1, referred to as Ethernet 0/1
- Slot 0, serial interface 0, referred to as serial 0/0
- Slot 0, serial interface 1, referred to as serial 0/1
- Slot 1, Ethernet interface 0, referred to as Ethernet 1/0
- Slot 1, Ethernet interface 1, referred to as Ethernet 1/1

- Slot 1, serial interface 0, referred to as serial 1/0
- Slot 1, BRI interface 0, referred to as BRI 1/0

Note The 2E 2-slot module described in this example provides both an attachment unit interface (AUI) and 10BaseT port. Only one of these ports can be used at a time. The module automatically detects which port, AUI or 10BaseT, is in use.

Voice Interface Numbering in Cisco 3600 Series Routers

Voice interfaces are numbered differently from WAN interfaces described in the previous section, "Unit Numbering." Voice interfaces are numbered as follows:

interface type chassis slot/voice module slot/voice interface

If you have a four-channel voice network module installed in slot 1 of your router, the voice interfaces will be:

- Slot 1, voice network module slot 0, voice interface 0, referred to as voice 1/0/0 (closest to chassis slot 0)
- Slot 1, voice network module slot 0, voice interface 1, referred to as voice 1/0/1
- Slot 1, voice network module slot 1, voice interface 0, referred to as voice 1/1/0
- Slot 1, voice network module slot 1, voice interface 1, referred to as voice 1/1/1 (farthest from chassis slot 0)

Cisco 2600 Series Routers

Table 1-2 lists the network module options available for Cisco 2600 series routers with their minimum software requirements for Cisco IOS Release 11.3 and 11.3 T.

Table 1-2 Network Module Options with Cisco IOS Releases for Cisco 2600 Series Routers

Network Module	Cisco Product Number	Cisco IOS Release 11.3 T
1-Port Ethernet	NM-1E	11.3(4)T
4-Port Ethernet	NM-4E	11.3(4)T
4-Port/8-Port Asynchronous/Synchronous Serial	NM-4A/S NM-8A/S	11.3(3)T, 11.3(2) XA
16-Port/32-Port Asynchronous Serial	NM-16A NM-32A	11.3(3)T, 11.3(2) XA
1-Port/2-Port Voice	NM-1V NM-2V	11.3(3)T, 11.3(2) XA
4-Port/8-Port ISDN BRI S/T[1]	NM-4B-S/T NM-8B-S/T	11.3(4)T
4-Port/8-Port ISDN BRI[2] with NT1	NM-4B-U NM-8B-U	11.3(4)T
1-Port/2-Port Channelized T1/ISDN PRI	NM-1CT1 NM-2CT1	11.3(4)T
1-Port/2-Port Channelized T1/ISDN PRI with CSU	NM-1CT1-CSU NM-2CT1-CSU	11.3(4)T
1-Port/2Port Channelized E1/ISDN PRI Unbalanced	NM-1CE1U NM-2CE1U	11.3(4)T
1-Port/2-Port Channelized E1/ISDN PRI Balanced	NM-1CE1B NM-2CE1B	11.3(4)T
8-Port and 16-Port Analog Modem	NM-8AM NM-16AM	11.3(4)T
1-Port ATM-25	NM-1ATM-25	11.3(4)T

1 The BRI S/T module requires an external NT1.
2 The BRI U module does not require an external NT1.

Cisco 2600 Series Interface Numbering

Each individual network interface on a Cisco 2600 series router is identified by a slot number and a unit number.

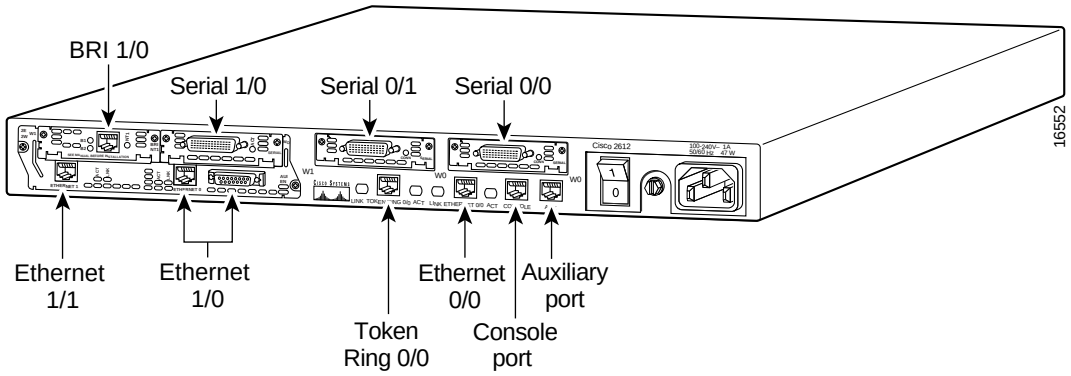
Slot and Unit Numbering

The Cisco 2600 series router chassis contains one slot in which you can install a network module. This is always slot 1.

Unit numbers identify the interfaces on the modules and WAN interface cards installed in the router. Unit numbers begin at 0 for each interface type, and continue from right to left and (if necessary) from bottom to top. Modules and WAN interface cards are identified by interface type, slot number, followed by a forward slash (/), and then the unit number; for example, Ethernet 0/0.

Figure 1-4 shows a router with a 2E 2-slot module in slot 1. One serial and one ISDN BRI WAN interface card are installed in the module.

Figure 1-4 Cisco 2600 Series Unit Numbers



Note WAN interface card slots (built into the chassis) are always numbered as slot 0, even if the interface card is installed in the slot labeled W1.

Figure 1-4 shows the following unit numbers:

- First Ethernet interface, referred to as Ethernet 0/0
- Token ring interface, referred to as Token Ring 0/0
- Slot W0, serial interface 0, referred to as serial 0/0
- Slot W1, serial interface 1, referred to as serial 0/1
- Slot 1, Ethernet interface 0, referred to as Ethernet 1/0
- Slot 1, Ethernet interface 1, referred to as Ethernet 1/1
- Slot 1, serial interface 0, referred to as serial 1/0
- Slot 1, BRI interface 0, referred to BRI 1/0

Note The 2E 2-slot module described in this example provides both an attachment unit interface (AUI) and 10BaseT port. Only one of these ports can be used at a time. The module automatically detects which port, AUI or 10BaseT, is in use.

Voice Interface Numbering in Cisco 2600 Series Routers

Voice interfaces are numbered differently from WAN interfaces described in the previous section, “Slot and Unit Numbering.” Voice interfaces are numbered as follows:

interface type chassis slot/voice module slot/voice interface

If you have a four-channel voice network module installed in slot 1 of your router, the voice interfaces will be:

- Slot 1, voice network module slot 0, voice interface 0, referred to as voice 1/0/0 (closest to the chassis WAN interface card slots)
- Slot 1, voice network module slot 0, voice interface 1, referred to as voice 1/0/1
- Slot 1, voice network module slot 1, voice interface 0, referred to as voice 1/1/0
- Slot 1, voice network module slot 1, voice interface 1, referred to as voice 1/1/1 (farthest from the chassis WAN interface card slots)

CHAPTER 2

Preparing to Install Network Modules

This chapter describes important information to consider before you begin to install network modules in Cisco modular routers, and includes the following sections:

- Safety Information on page 2-1
- Required Tools and Equipment on page 2-4

Safety Information

This section contains safety warnings that you should be aware of before installing a network module in the router.

Safety Recommendations

Follow these guidelines to ensure general safety:

- Keep the chassis area clear and dust-free during and after installation.
- Put the removed chassis cover in a safe place.
- Keep tools away from walk areas where you or others could fall over them.
- Do not wear loose clothing that could get caught in the chassis. Fasten your tie or scarf and roll up your sleeves.
- Wear safety glasses when working under any conditions that might be hazardous to your eyes.
- Do not perform any action that creates a potential hazard to people or makes equipment unsafe.

Safety Warnings

Safety warnings appear throughout this publication in procedures that, if performed incorrectly, may harm you. A warning symbol precedes each warning statement.

Safety with Electricity

Warning Before working on equipment that is connected to power lines, remove jewelry (including rings, necklaces, and watches). Metal objects will heat up when connected to power and ground and can cause serious burns or weld the metal object to the terminals.

Warning To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. LAN ports contain SELV circuits, and WAN ports contain TNV circuits. Both LAN and WAN ports may use RJ-45 connectors. Use caution when connecting cables.

Warning Hazardous network voltages are present in WAN ports regardless of whether power to the router is OFF or ON. To avoid electric shock, use caution when working near WAN ports. When detaching cables, detach the end away from the router first.

Warning Before opening the chassis, disconnect the telephone-network cables to avoid contact with telephone-network voltages.

Warning Do not work on the system or connect or disconnect cables during periods of lightning activity.

Warning Do not touch the power supply when the power cord is connected. For systems with a power switch, line voltages are present within the power supply even when the power switch is OFF and the power cord is connected. For systems without a power switch, line voltages are present within the power supply when the power cord is connected.

Follow these guidelines when working on equipment powered by electricity:

- Locate the emergency power-off switch in the room in which you are working. Then, if an electrical accident occurs, you can quickly shut the power OFF.
- Before working on the router, turn OFF the power and unplug the power cord.
- Disconnect all power before doing the following:
  - Installing or removing a router chassis
  - Working near power supplies
- Do not work alone if potentially hazardous conditions exist.
- Never assume that power is disconnected from a circuit. Always check.
- Look carefully for possible hazards in your work area, such as moist floors, ungrounded power extension cables, and missing safety grounds.
- If an electrical accident occurs, proceed as follows:
  - Use caution; do not become a victim yourself.
  - Turn OFF power to the router.
  - If possible, send another person to get medical aid. Otherwise, determine the condition of the victim and then call for help.
  - Determine if the person needs rescue breathing or external cardiac compressions; then take appropriate action.

Preventing Electrostatic Discharge Damage

Electrostatic discharge (ESD) can damage equipment and impair electrical circuitry. It occurs when electronic printed circuit cards are improperly handled and can result in complete or intermittent failures. Always follow ESD prevention procedures when removing and replacing cards. Ensure that the router chassis is electrically connected to earth ground. Wear an ESD-preventive wrist strap, ensuring that it makes good skin contact. Connect the clip to an unpainted surface of the chassis frame to safely channel unwanted

ESD voltages to ground. To properly guard against ESD damage and shocks, the wrist strap and cord must operate effectively. If no wrist strap is available, ground yourself by touching the metal part of the chassis.

Caution For safety, periodically check the resistance value of the antistatic strap, which should be between 1 and 10 megohm (Mohm).

Required Tools and Equipment

You need the following tools and equipment to install a network module in a Cisco modular router chassis slot:

- Number 1 Phillips screwdriver or small flat-blade screwdriver
- ESD-preventive wrist strap

CHAPTER 3

Installing Network Modules in Cisco Modular Routers

This chapter describes how to install network modules in Cisco modular routers, and includes the following sections:

- Installing a Network Module in a Modular Router Chassis Slot on page 3-1
- Installing a WAN Interface Card in a Network Module Slot on page 3-3

Installing a Network Module in a Modular Router Chassis Slot

Caution Network modules do not support online insertion and removal (hot swap). To avoid damaging the module, before you insert a network module into a chassis slot, you must turn OFF electrical power and disconnect network cables.

The following instructions apply only to installing network modules in a modular router chassis slot. To install a WAN interface card in a network module, see the "Installing a WAN Interface Card in a Network Module Slot" section on page 3-3.

You can install network modules in the chassis either before or after mounting the router, whichever is more convenient.

Follow this procedure to install a network module:

Step 1 Turn OFF electrical power to the router. However, to channel electrostatic discharge (ESD) voltages to ground, do not unplug the power cable. Remove all network interface cables, including telephone cables, from the rear panel.

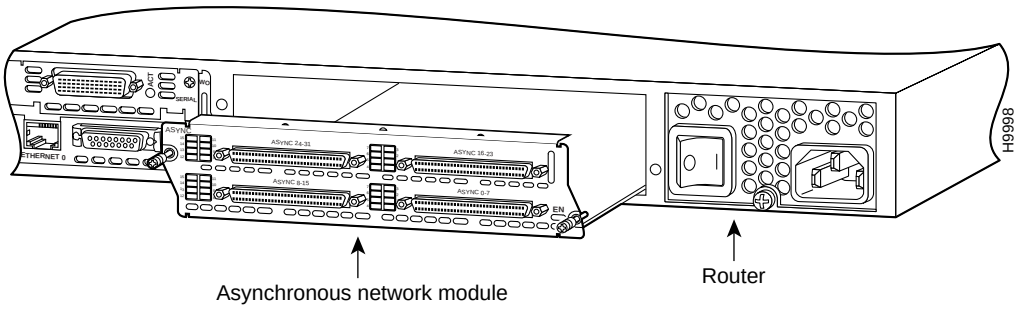
The following warning applies to routers that use a DC power supply:

Warning Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position.

Step 2 Using either a number 1 Phillips screwdriver or a small flat-blade screwdriver, remove the blank filler panel from the chassis slot where you plan to install the module. Save the blank panel for future use.

Step 3 Align the network module with the guides in the chassis and slide it gently into the slot. (See Figure 3-1.)

Figure 3-1 Installing a Network Module in a Modular Router (Typical)



Step 4 Push the module into place until you feel its edge connector mate securely with the connector on the motherboard.

Step 5 Fasten the module's captive mounting screws into the holes in the chassis, using the Phillips or flat-blade screwdriver.

Step 6 If the router was previously running, reinstall the network interface cables and turn ON power to the router.

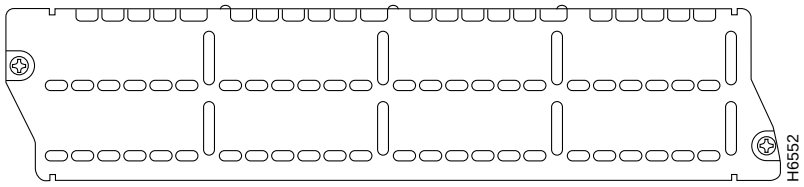
The following warning applies to routers that use a DC power supply:

Warning After wiring the DC power supply, remove the tape from the circuit breaker switch handle and reinstate power by moving the handle of the circuit breaker to the ON position.

Blank Network Module Panels

If the router is not fully configured with network modules, make sure that blank panels fill the unoccupied chassis slots to provide proper airflow. (See Figure 3-2.)

Figure 3-2 Blank Network Module Panel



Installing a WAN Interface Card in a Network Module Slot

The following instructions apply only to installing a WAN interface card in a module slot. To install a module in a chassis slot, see the “Installing a Network Module in a Modular Router Chassis Slot” section on page 3-1. To see translated versions of the warnings that appear in this chapter, see the *Regulatory Compliance and Safety Information* document that accompanied the router.

Warning Only trained and qualified personnel should be allowed to install or replace this equipment.

Warning Do not insert a WAN interface card into a base module slot while power is ON or network cables are connected.

Warning Before opening the chassis, disconnect the telephone-network cables to avoid contact with telephone-network voltages.

Warning Do not work on the system or connect or disconnect cables during periods of lightning activity.

Warning To avoid electric shock, do not insert a WAN interface card into a two-slot module while power is ON or network cables are connected.

Note A WAN interface card can be installed in a module that is already installed in a router. Before inserting a WAN interface card into a base module that is already installed in the router chassis, you must turn OFF electrical power.

Note Do not install an Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI) WAN interface card or an ISDN BRI network module in the same chassis as an ISDN Primary Rate Interface (PRI) network module, unless you are using Cisco IOS Release 11.3(3)T or later. Earlier releases of Cisco IOS software do not support this configuration.

Note Do not install a newer BRI WAN interface card in the same network module as an older BRI WAN interface card. The easiest way to identify the newer and older cards is to observe the LED placement: on the newer card, the B-channel LEDs are arranged horizontally and on the older card, the B-channel LEDs are arranged vertically.

You need either a number 1 Phillips screwdriver or a flat-blade screwdriver. To install a WAN interface card, follow this procedure:

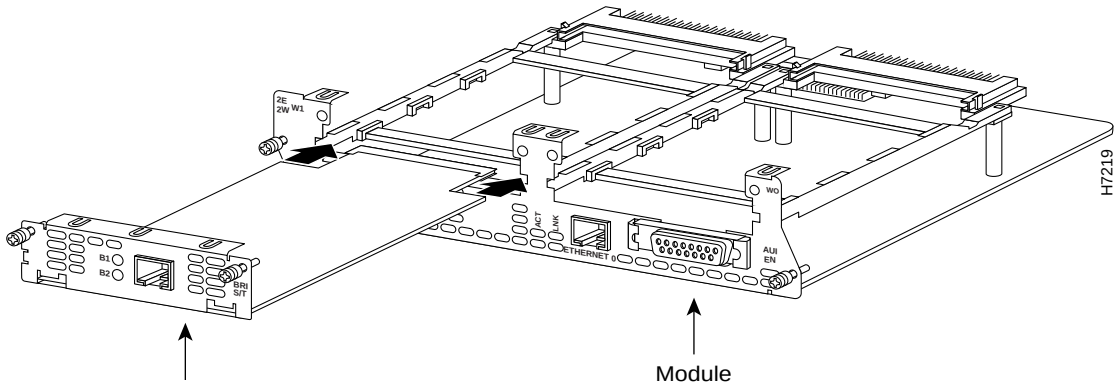
Step 1 If you are installing the card directly into a base module in the router, turn OFF power to the router. However, to channel ESD voltages to ground, do not unplug the power cable. Remove all network interface cables, including telephone cables, from the rear panel.

If you are installing the card into the base module outside the router, attach an ESD-preventive wrist strap and ensure that it makes good contact with your skin. Connect the equipment end of the wrist strap to an electrical ground.

Step 2 Using a Phillips or flat-blade screwdriver, remove the blank filler panel from the base module slot where you plan to install the card. Save the filler panel for possible future use.

Step 3 Align the card with the guides in the module slot and slide it gently in. (See Figure 3-3.)

Figure 3-3 Installing a WAN Interface Card in a Network Module (Typical)



Step 4 Push the card into place until the edge connector is securely seated in the connector on the module.

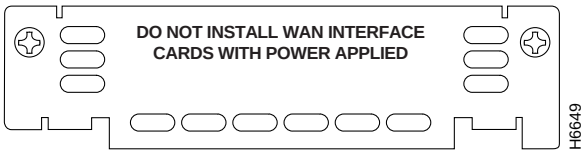
Step 5 Secure the captive mounting screws into the holes of the module faceplate, using a Phillips or flat-blade screwdriver.

Step 6 If the router was previously running, reinstall the network interface cables and power ON the router.

WAN Interface Card Filler Panels

If the base module is configured with only one WAN interface card, secure a slot filler panel into the open base module slot to ensure proper airflow. (See Figure 3-4.)

Figure 3-4 WAN Interface Card Slot Filler Panel



After installing any WAN interface cards you may have, if you need assistance in installing a network module in your router, see the "Installing a Network Module in a Modular Router Chassis Slot" section on page 3-1.

The next chapters in this guide contain connection and LED information for Cisco network modules. Proceed to the chapter that corresponds to your type of network module:

- Chapter 4, "Connecting Ethernet Network Modules to a Network"
- Chapter 5, "Connecting Fast Ethernet PRI Network Modules to a Network"
- Chapter 6, "Connecting Serial Network Modules to a Network"
- Chapter 7, "Connecting ISDN BRI Network Modules to a Network"
- Chapter 8, "Connecting ISDN PRI Network Modules to a Network"
- Chapter 9, "Connecting Voice Network Modules to a Network"
- Chapter 10, "Connecting Digital Modem Network Modules to a Network"
- Chapter 11,"Connecting Analog Modem Network Modules to a Network"

- Chapter 12, “Connecting ATM Network Modules to a Network”
- Chapter 13, “Connecting HSSI Network Modules to a Network”
- Chapter 14, “Connecting Compression Network Modules to a Network”

CHAPTER 4

Connecting Ethernet Network Modules to a Network

This chapter describes how to connect and configure Ethernet network modules in Cisco modular routers, and describes the following modules:

- 1-Port and 4-Port Ethernet Modules on page 4-1
- 1-Port Fast Ethernet Module on page 4-5

1-Port and 4-Port Ethernet Modules

This section provides information about the following network modules for Cisco modular routers:

- 1-port Ethernet network module—(Cisco product number NM-1E). (See Figure 4-1.)
- 4-port Ethernet network module—(Cisco product number NM-4E). (See Figure 4-2.)

Figure 4-1 1-Port Ethernet Network Module

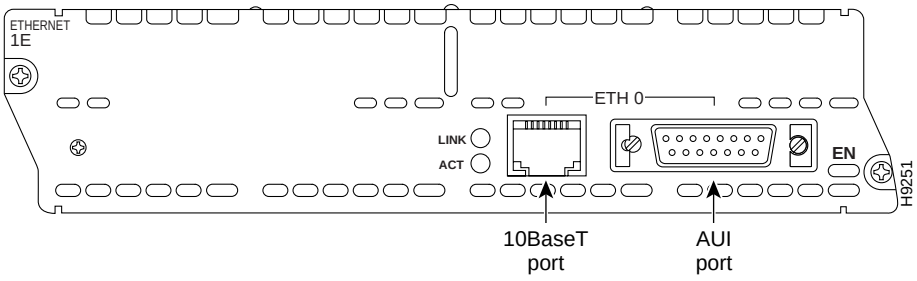
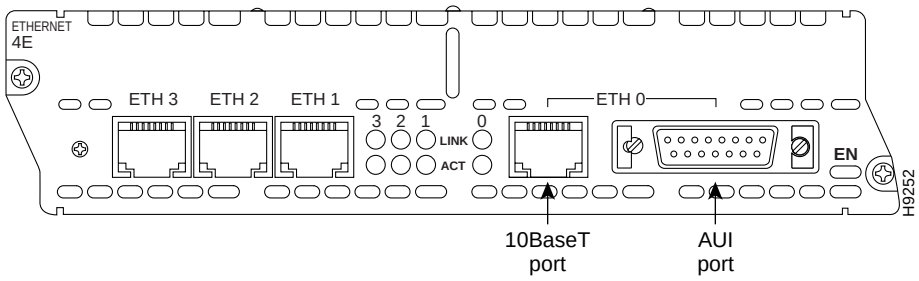


Figure 4-2 4-Port Ethernet Network Module



Ethernet Network Module Connectors

The 1-port Ethernet network module has a single port (Ethernet port 0) for one Ethernet connection. The 4-port Ethernet network module has ports for four Ethernet connections. (See Figure 4-2.) Ethernet port 0 uses either the attachment unit interface (AUI) (DB-15) connector on the right side of the module or the 10BaseT (RJ-45) connector next to it. Only one of these connectors can be active at a time. Ethernet ports 1, 2, and 3 on the 4-port Ethernet module use 10BaseT connectors. These ports do not provide an AUI connector.

Active ports are identified in software by port type (Ethernet), the module's slot number, and the port number.

On port 0, the module detects the type of network connection automatically, and you do not need to select the media type when you configure the software. If cables are plugged into both the AUI connector and the 10BaseT connector for the same port, the 10BaseT connection is selected.

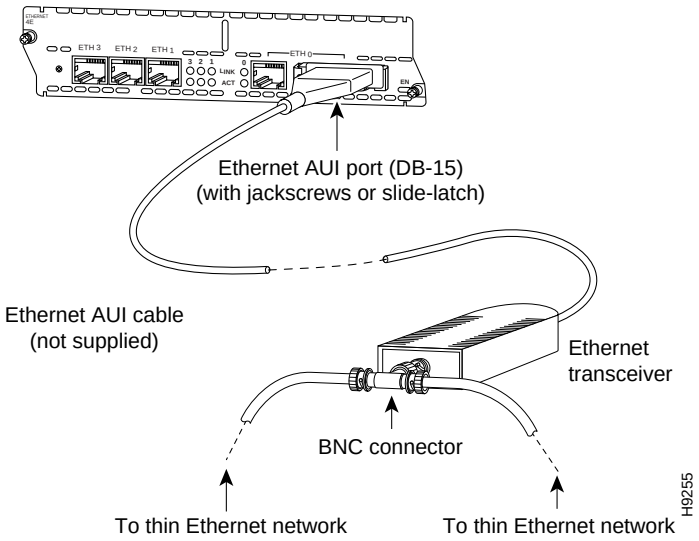
Connecting Ethernet Ports

On Ethernet port 0 (the right port), you can connect either the Ethernet AUI connector or the 10BaseT connector, but not both at the same time. Ports 1, 2, and 3 provide only a 10BaseT connector.

AUI Connections

Use an Ethernet AUI cable to connect the AUI port on the 1-port or 4-port Ethernet network module to an Ethernet transceiver. The female end of the AUI cable mates with the slide-latch connector of the transceiver cable. Figure 4-3 shows a thin Ethernet transceiver as an example, but you can use any type of Ethernet transceiver.

Figure 4-3 Connecting an Ethernet AUI Port to a Transceiver

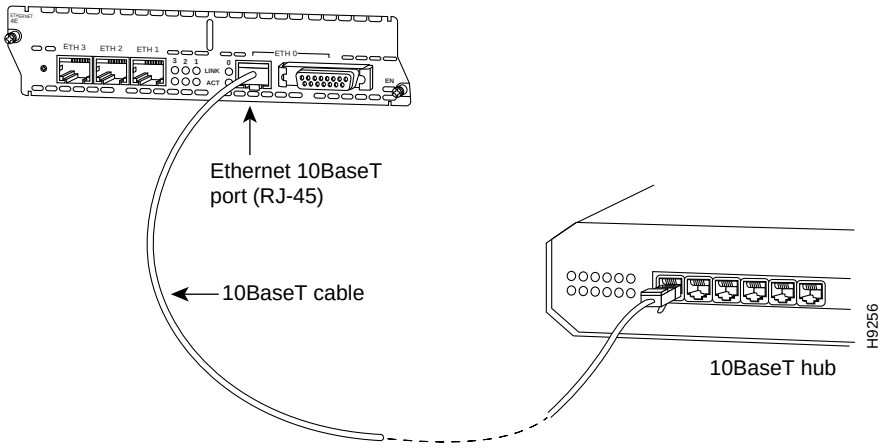


If the transceiver cable has thumbscrew connectors, you can connect it directly to the AUI port by replacing the AUI port slide latch with a jackscrew (provided in a separate bag).

10BaseT Connections

Use an Ethernet 10BaseT cable to connect a 10BaseT port on the 1-port or 4-port Ethernet network module to a hub or other network device. Figure 4-4 shows the 10BaseT port on an Ethernet network module connected to a hub.

Figure 4-4 Connecting an Ethernet 10BaseT Port to a Hub



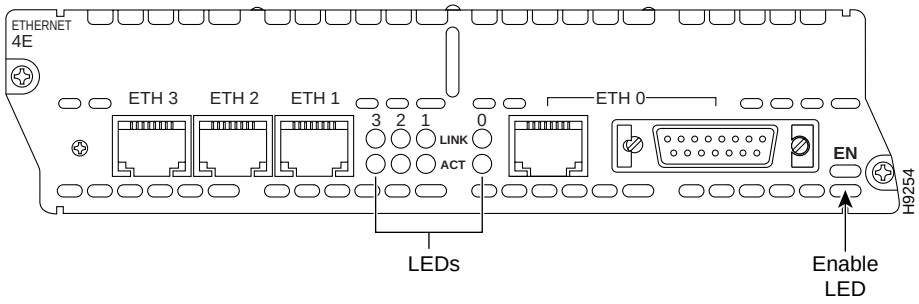
1-Port and 4-Port Ethernet Network Module LEDs

This section describes the LEDs for the 1-port and 4-port Ethernet network module. Figure 4-5 shows the 4-port Ethernet network module's LEDs, however these apply to the 1-port Ethernet network module as well.

All network modules have an enable (EN) LED. The enable LED indicates that the module has passed its self-tests and is available to the router.

Each Ethernet port has two LEDs. The activity (ACT) LED indicates that the router is sending or receiving Ethernet transmissions. The link (LINK) LED indicates that the Ethernet port is receiving the link integrity signal from the hub (10BaseT only).

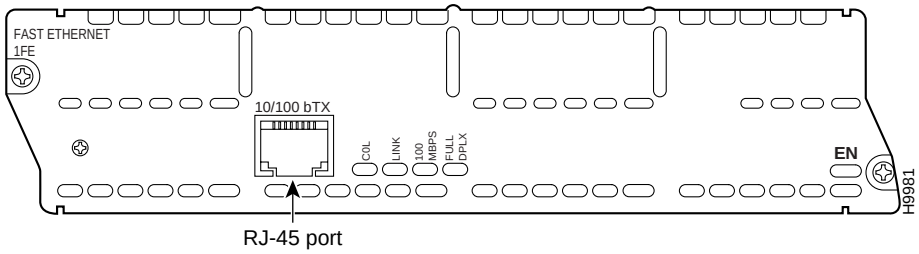
Figure 4-5 Ethernet Network Module LEDs (Typical)



1-Port Fast Ethernet Module

This section provides information about the 1-port Fast Ethernet network module (Cisco product number NM-1FE-TX) for Cisco modular routers. (See Figure 4-6.) This module enables the router to connect to 100-Mbps Ethernet networks and create high-speed communication links between network devices.

Figure 4-6 1-Port Fast Ethernet Network Module

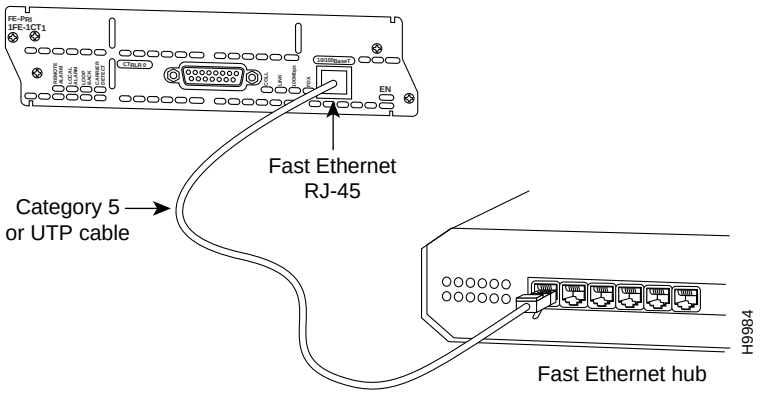


Connecting Fast Ethernet Ports

Use a two-pair Category 5 or unshielded twisted-pair (UTP) straight-through RJ-45 cable to connect the RJ-45 port on a 1-port Fast Ethernet network module to a switch, hub, repeater, server, or other network device. Figure 4-7 shows the RJ-45 port connected to a hub.

Note RJ-45 cables are not available from Cisco Systems. These cables are widely available and must be Category 5 cables.

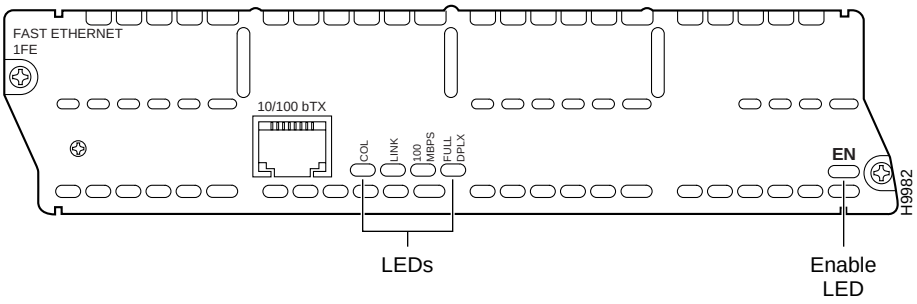
Figure 4-7 Connecting a Fast Ethernet RJ-45 Port to a Hub



1-Port Fast Ethernet Network Module LEDs

Figure 4-8 shows the 1-port Fast Ethernet network module's LEDs.

Figure 4-8 1-Port Fast Ethernet Network Module LEDs



All network modules have an enable (EN) LED. The enable LED indicates that the module has passed its self-tests and is available to the router.

The 1-port Fast Ethernet network module has the additional LEDs shown in Table 4-1.

Table 4-1 Fast Ethernet Network Module LEDs

LED	Meaning
COL	Collision activity is occurring on the network
LINK	A link has been established with the station at the other end of the cable
100MBPS	Speed of the interface is 100 Mbps
FULL DPLX	Interface is in full-duplex mode

CHAPTER 5

Connecting Fast Ethernet PRI Network Modules to a Network

Note Fast Ethernet network modules are supported in Cisco 3600 series routers only.

This chapter describes how to connect Fast Ethernet-Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI) network modules in Cisco 3600 series routers, and describes the following modules:

- 1-Port Fast Ethernet and 1-Port or 2-Port Channelized T1/ISDN PRI Network Modules on page 5-2
- 1-Port Fast Ethernet and 1-Port or 2-Port Channelized T1/ISDN PRI with CSU Network Modules on page 5-5
- 1-Port Fast Ethernet and 1-Port Channelized E1/ISDN PRI Balanced (120-ohm) or Unbalanced (75-ohm) Network Modules on page 5-7
- 1-Port Fast Ethernet and 2-Port Channelized E1/ISDN PRI Balanced (120-ohm) or Unbalanced (75-ohm) Network Modules on page 5-8
- Fast Ethernet PRI Module LEDs on page 5-12

Note These network modules provide ports for connection both to a 10- or 100-Mbps Ethernet LAN and to an ISDN PRI LAN.

Note Unless specifically identified, references to Fast Ethernet PRI network modules in this chapter include all these network modules.

1-Port Fast Ethernet and 1-Port or 2-Port Channelized T1/ISDN PRI Network Modules

This section provides information about the following network modules for Cisco 3600 series modular routers.

- 1-port Fast Ethernet 1-port channelized T1/ISDN PRI network module—Cisco product number NM-1FE1CT1. (See Figure 5-1.)
- 1-port Fast Ethernet 2-port channelized T1/ISDN PRI network module—Cisco product number NM-1FE2CT1. (See Figure 5-2.)

Figure 5-1 1-Port Fast Ethernet 1-Port Channelized T1 Network Module

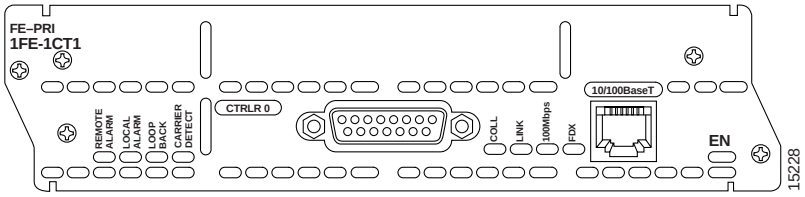
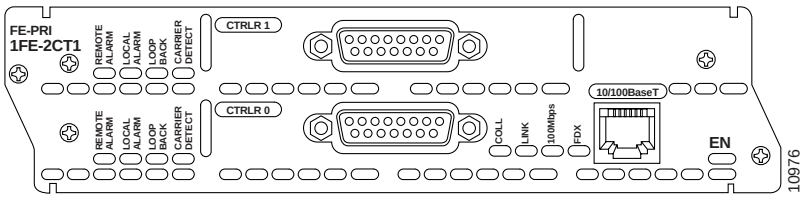


Figure 5-2 1-Port Fast Ethernet 2-Port Channelized T1 Network Module



Connecting Fast Ethernet Channelized T1 Modules to the Network

In order to connect Fast Ethernet channelized T1 modules to the network, complete the following:

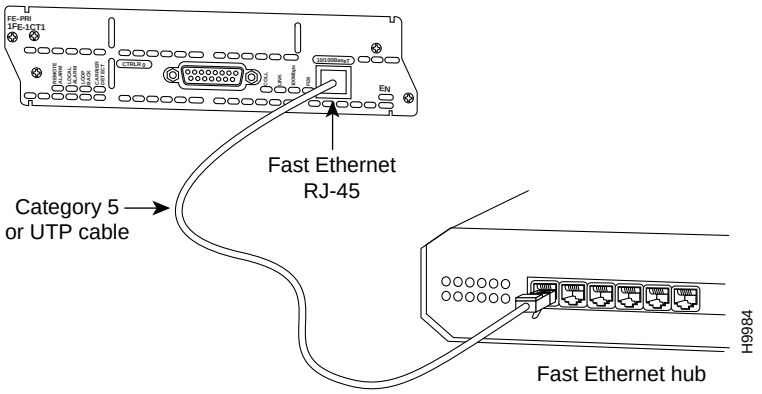
- Connecting the Fast Ethernet Port on page 5-3
- Connecting the PRI Ports on page 5-4

Connecting the Fast Ethernet Port

Use a straight-through two-pair Category 5 unshielded twisted-pair (UTP) cable to connect the RJ-45 port on the Fast Ethernet PRI network module to a switch, hub, repeater, server, or other network device. These ports are color-coded yellow. Figure 5-3 shows the RJ-45 port connected to a hub.

Note RJ-45 cables are not available from Cisco Systems. These cables are widely available and must be Category 5 cables.

Figure 5-3 Connecting a Fast Ethernet RJ-45 Port to a Hub

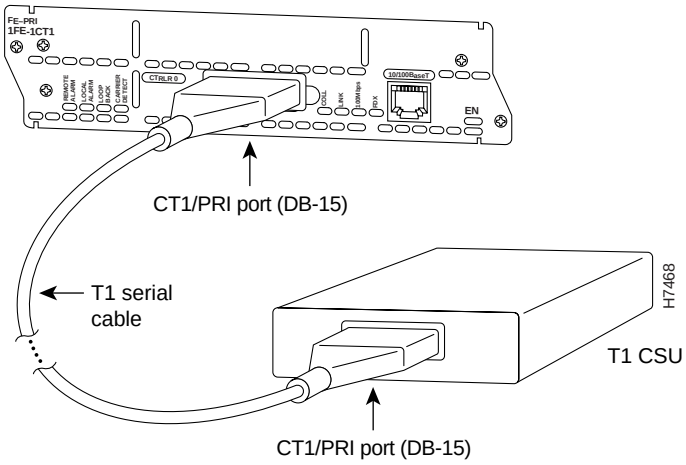


Connecting the PRI Ports

This section describes how to connect channelized T1 and channelized E1 ISDN PRI ports to the network. These ports are color-coded tan.

Use a DB-15-to-DB-15 T1 serial cable to connect a CT1/PRI port to a T1 channel service unit (CSU). (See Figure 5-4.)

Figure 5-4 Connecting a CT1/PRI Port to a T1 CSU



1-Port Fast Ethernet and 1-Port or 2-Port Channelized T1/ISDN PRI with CSU Network Modules

This section provides information about the following network modules for Cisco 3600 series modular routers:

- 1-port Fast Ethernet 1-port channelized T1/ISDN PRI with CSU network module—Cisco product number NM-1FE1CT1-CSU. (See Figure 5-5.)
- 1-port Fast Ethernet 2-port channelized T1/ISDN PRI with CSU network module—Cisco product number NM-1FE2CT1-CSU. (See Figure 5-6.)

Figure 5-5 1-Port Fast Ethernet 1-Port Channelized T1 with CSU Network Module

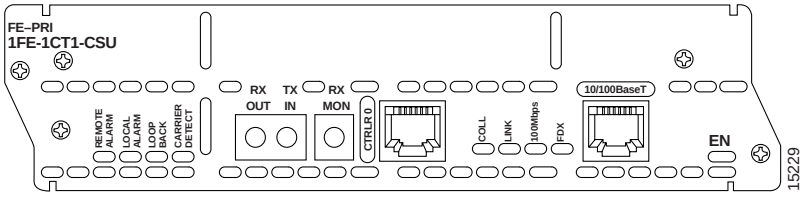
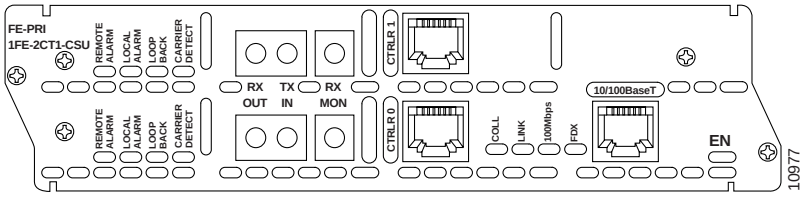


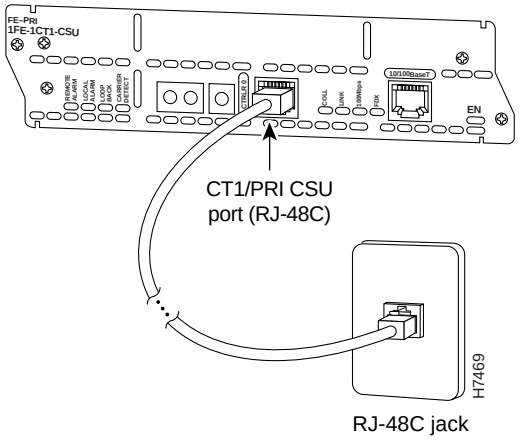
Figure 5-6 1-Port Fast Ethernet 2-Port Channelized T1 with CSU Network Module



Connecting Fast Ethernet with Channelized T1 and CSU Modules to the Network

Use a straight-through RJ-48C-to-RJ-48C cable to connect a CT1/PRI-CSU port to an RJ-48C jack. (See Figure 5-7.)

Figure 5-7 Connecting a CT1/PRI-CSU Port to an RJ-48C Jack

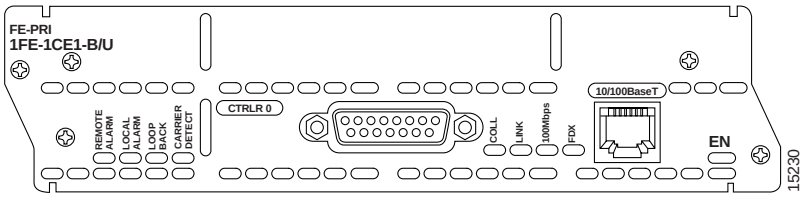


1-Port Fast Ethernet and 1-Port Channelized E1/ISDN PRI Balanced (120-ohm) or Unbalanced (75-ohm) Network Modules

This section provides information about the following network modules for Cisco 3600 series modular routers.

- 1-port Fast Ethernet 1-port channelized E1/ISDN PRI balanced (120-ohm) network module—Cisco product number NM-1FE1CE1B. (See Figure 5-8.)
- 1-port Fast Ethernet 1-port channelized E1/ISDN PRI unbalanced (75-ohm) network module—Cisco product number NM-1FE1CE1U. (See Figure 5-8.)

Figure 5-8 1-Port Fast Ethernet 1-Port Channelized E1 Network Module



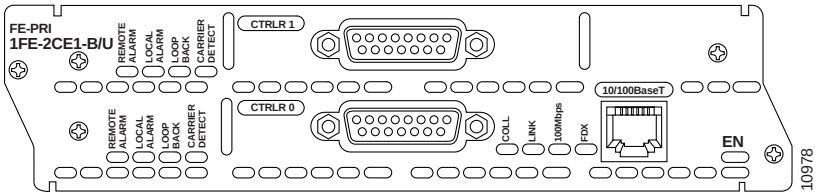
For information on connecting these modules to a network, see the "Connecting Fast Ethernet Channelized E1 Modules to the Network" section on page 5-9.

1-Port Fast Ethernet and 2-Port Channelized E1/ISDN PRI Balanced (120-ohm) or Unbalanced (75-ohm) Network Modules

This section provides information about the following network modules for Cisco 3600 series modular routers.

- 1-port Fast Ethernet 2-port channelized E1/ISDN PRI balanced (120-ohm) network module—Cisco product number NM-1FE2CE1B. (See Figure 5-9.)
- 1-port Fast Ethernet 2-port channelized E1/ISDN PRI unbalanced (75-ohm) network module—Cisco product number NM-1FE2CE1U. (See Figure 5-9.)

Figure 5-9 1-Port Fast Ethernet 2-Port Channelized E1 Network Module



Connecting Fast Ethernet Channelized E1 Modules to the Network

In addition to the Fast Ethernet connection (see Figure 5-3), connect one of the following:

- CE1/PRI-B Port on page 5-9
- CE1/PRI-U Port on page 5-11

CE1/PRI-B Port

Use the appropriate cable to connect a CE1/PRI-B (120-ohm) port to an E1 CSU. (See Figure 5-10, Figure 5-11, and Figure 5-12, showing DB-15, twinax, and RJ-45 CSUs respectively.)

Figure 5-10 Connecting a CE1/PRI-B Port to an E1 CSU (DB-15-to-DB-15 Connectors)

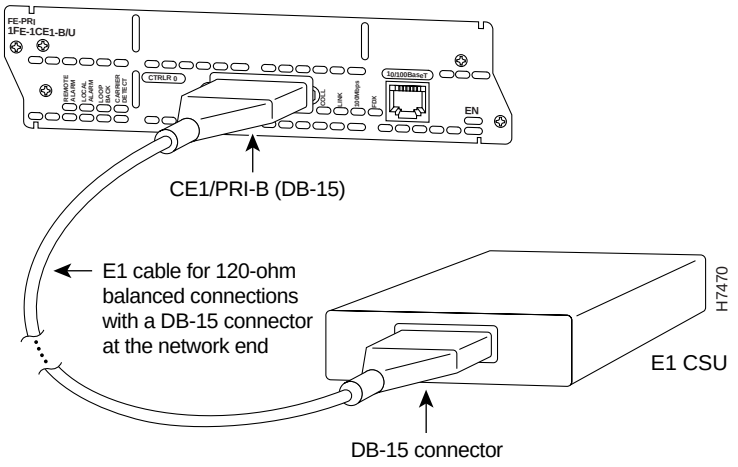


Figure 5-11 Connecting a CE1/PRI-B Port to an E1 CSU (DB-15-to-Twinax Connectors)

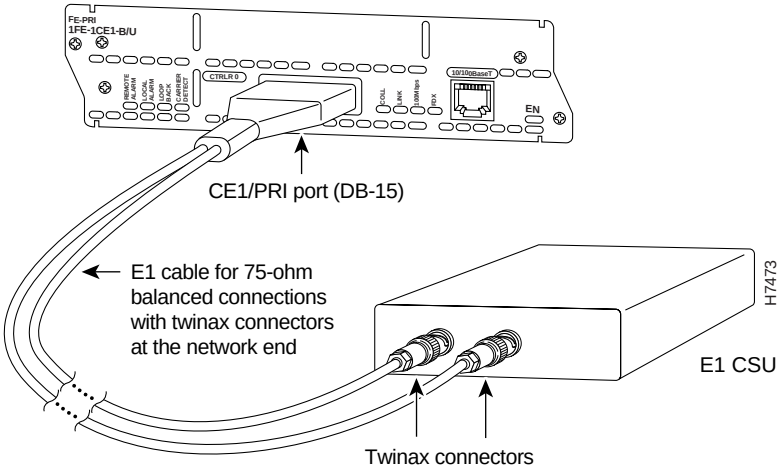
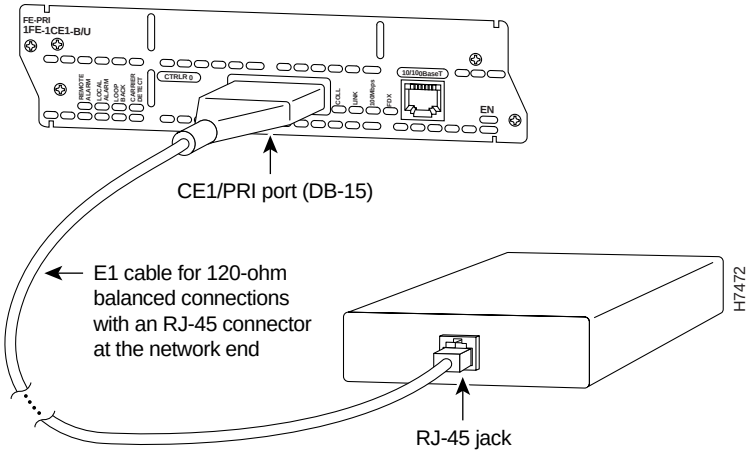


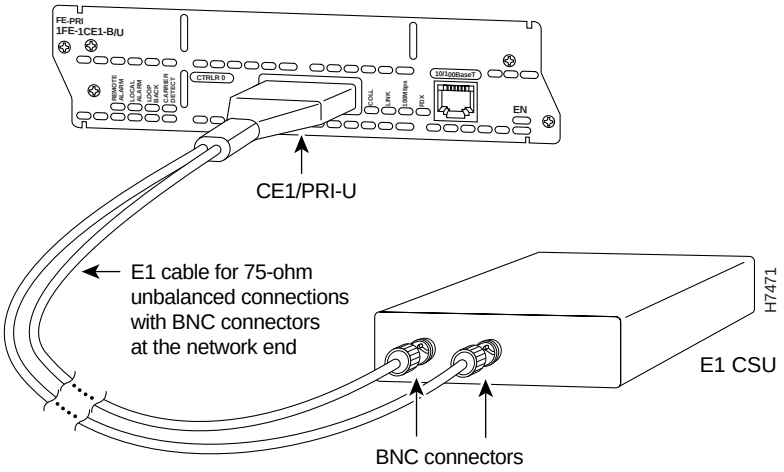
Figure 5-12 Connecting a CE1/PRI-B Port to an E1 CSU (DB-15-to-RJ-45 Connectors)



CE1/PRI-U Port

Use the appropriate cable to connect a CE1/PRI-U (75-ohm) port to an E1 CSU. Figure 5-13 shows a CSU with BNC connectors.

Figure 5-13 Connecting a CE1/PRI-U Module to an E1 CSU (DB-15-to-BNC Connectors)



Fast Ethernet PRI Module LEDs

All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

All Fast Ethernet PRI modules have four LEDS for the Fast Ethernet port, and four additional LEDs for each PRI port. Figure 5-14 shows LEDs for the 1-port Fast Ethernet 2-port channelized E1/ISDN PRI balanced (120-ohm) network module as an example.

Figure 5-14 Fast Ethernet and ISDN PRI LEDs

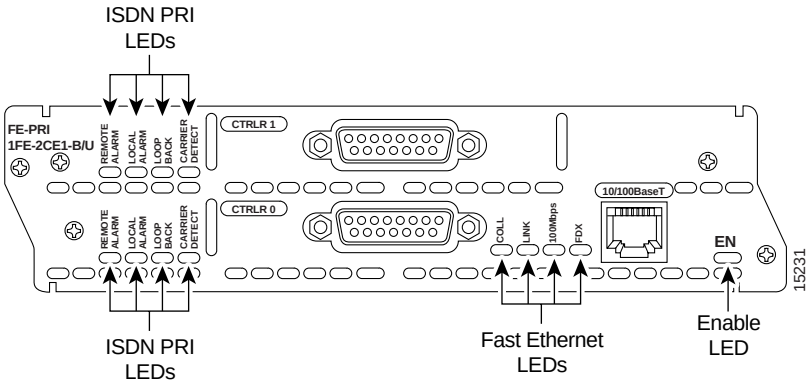


Table 5-1 describes Fast Ethernet LEDs. Table 5-2 describes ISDN PRI LEDs.

Table 5-1 Fast Ethernet LEDs

LED	Color	Meaning
COLL	Yellow	Collision activity is occurring on the network.
LINK	Green	A link has been established with the station at the other end of the cable.
100Mbps	Green	Speed of the interface is 100 Mbps.
FDX	Green	Interface is in full-duplex mode.

Table 5-2 ISDN PRI LEDs

LED	Color	Meaning
REMOTE ALARM	Yellow	A remote source is indicating an error at its end of the connection.
LOCAL ALARM	Yellow	Incoming signal shows loss of signal, loss of frame, or excessive errors.
LOOPBACK	Yellow	Line or local loopback state is set or detected.
CARRIER DETECT	Green	DS-1 carrier to the network is detected.

CHAPTER 6

Connecting Serial Network Modules to a Network

This chapter describes how to connect and configure serial network modules in Cisco modular routers, and describes the following:

- About Serial Connections on page 6-1
- Connecting Asynchronous Network Modules to Asynchronous Devices on page 6-4
- Asynchronous Network Modules Interface Numbering on page 6-5
- 4-Port Serial Network Module on page 6-10
- 16-Port and 32-Port Asynchronous Serial Network Module on page 6-13
- 4-Port and 8-Port Asynchronous/Synchronous Serial Network Module on page 6-15

About Serial Connections

Serial connections are provided by the WAN interface cards and network modules. The serial WAN interface card can be installed in either slot of a 2-slot module. For more information on WAN interface cards, see the publication *Cisco WAN Interface Cards Hardware Installation Guide*.

Before you connect a device to a serial port, you need to know the following:

- Type of device, data terminal equipment (DTE) or data communications equipment (DCE), you are connecting to the synchronous serial interface
- Type of connector, male or female, required to connect to the device
- Signaling standard required by the device

Serial DTE or DCE Devices

A device that communicates over a synchronous serial interface is either a DTE or DCE device. A DCE device provides a clock signal that paces the communications between the device and the router. A DTE device does not provide a clock signal. DTE devices usually connect to DCE devices. The documentation that accompanied the device should indicate whether it is a DTE or DCE device. (Some devices have a jumper to select either DTE or DCE mode.) If you cannot find the information in the documentation, see Table 6-1 to help you select the proper device type.

Table 6-1 Identifying the Device Type

Device Type	Gender	Typical Devices
DTE	Male[1]	Terminal
		PC
DCE	Female[2]	Modem
		CSU/DSU[3]
		Multiplexer

1 If pins protrude from the base of the connector, the connector is male.
2 If the connector has holes to accept pins, the connector is female.
3 CSU/DSU = channel service unit/data service unit.

Signaling Standards Supported

The synchronous serial ports available for the router support the following signaling standards: EIA/TIA-232, EIA/TIA-449, V.35, X.21, and EIA-530. You can order a Cisco DB-60 shielded serial transition cable that has the appropriate connector for the standard you specify. The documentation for the device you want to connect should indicate the standard used for that device. The router end of the shielded serial transition cable has a DB-60 connector, which connects to the DB-60 port on a serial WAN interface card. The other end of the serial transition cable is available with the connector appropriate for the standard you specify.

The synchronous serial port can be configured as DTE or DCE (except EIA-530, which is DTE only), depending on the attached cable. To order a shielded cable, contact customer service. (See the *Cisco Information Packet* publication that came with your router.)

Note All serial ports configured as DTE require external clocking from a CSU/DSU or other DCE device.

Although manufacturing your own serial cables is not recommended (because of the small size of the pins on the DB-60 serial connector), cable pinouts are provided in the online document *Cisco Modular Access Router Cable Specifications.* This document is located on the Documentation CD-ROM that accompanied your router, and on Cisco Connection Online.

Distance Limitations

Serial signals can travel a limited distance at any given bit rate; generally, the slower the data rate, the greater the distance. All serial signals are subject to distance limits, beyond which a signal degrades significantly or is completely lost.

Table 6-2 lists the recommended maximum speeds and distances for each serial interface type; however, if you understand potential electrical problems and compensate for them, you may get good results at speeds and distances greater than those listed. For instance, the recommended maximum rate for V.35 is 2 Mbps, but 4 Mbps is commonly used.

Table 6-2 Serial Interace Speeds and Distances

	EIA/TIA-232 Distance		EIA/TIA-449, X.21, V.35, EIA-530 Distance	
Rate (bps)	**Feet**	**Meters**	**Feet**	**Meters**
2400	200	60	4100	1250
4800	100	30	2050	625
9600	50	15	1025	312
19200	25	7.6	513	156

Table 6-2 Serial Interace Speeds and Distances (continued)

	EIA/TIA-232 Distance		EIA/TIA-449, X.21, V.35, EIA-530 Distance	
Rate (bps)	**Feet**	**Meters**	**Feet**	**Meters**
38400	12	3.7	256	78
56000	8.6	2.6	102	31
1544000 (T1)	–	–	50	15

Balanced drivers allow EIA/TIA-449 signals to travel greater distances than EIA/TIA-232 signals. The recommended distance limits for EIA/TIA-449 shown in Table 6-2 are also valid for V.35, X.21, and EIA-530. Typically, EIA/TIA-449 and EIA-530 support 2-Mbps rates, and V.35 can support 4-Mbps rates.

Asynchronous/Synchronous Serial Module Baud Rates

The following baud-rate limitations apply to the slow-speed serial interfaces found in the Asynchronous/Synchronous serial modules:

- The maximum baud rate on the slow-speed asynchronous interface is 115.2 kbps. The traffic throughput rate allowed will be full 115.2 kbps with 10 percent of traffic in the opposite direction.
- The maximum baud rate for the slow-speed synchronous interface is 128 kbps full duplex.

Connecting Asynchronous Network Modules to Asynchronous Devices

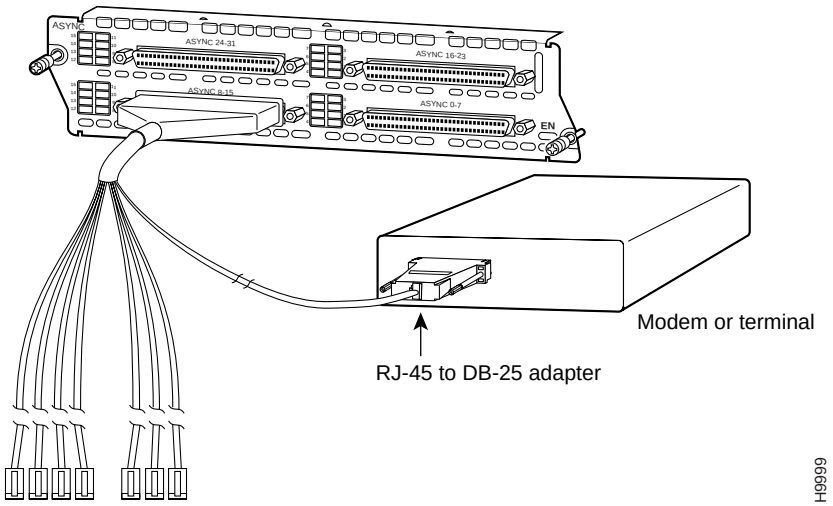
An asynchronous network module provides two or four 68-pin receptacles. Each receptacle connects to asynchronous devices by means of an octal cable that provides a 68-pin plug at the module end and eight connectors at the network end, one for each of the eight EIA/TIA-232 serial ports. Depending on the type of cable, the network end consists of either RJ-45 plugs or male DB-25 connectors. RJ-45-to-DB-25 adapters are also available.

Ports are numbered from right to left and from bottom to top, as labeled on the module's rear panel. (See the "Asynchronous Network Modules Interface Numbering" section on page 6-5.)

Octal cables are not provided with the network module. For ordering information, see the "Cisco Connection Online" section on page xiv.

Use an octal cable, and adapters if necessary, to connect each of the modules's 68-pin receptacles to one or more asynchronous modems, terminals, or other devices. (See Figure 6-1.)

Figure 6-1 Connecting an Asynchronous Network Module to an Asynchronous Device



Asynchronous Network Modules Interface Numbering

Certain Cisco IOS configuration commands identify asynchronous ports by an interface number (or a line number, which is the same as the interface number). The interface number of a port on a asynchronous network module is related to the slot number where the module is installed and the unit number of the port in the module.

Cisco 3600 Series 16-Port and 32-Port Interface Numbering

Cisco 3600 series routers slot numbers begin at 0 at the bottom right of the chassis, as viewed from the rear. For example, Cisco 3620 router slots are numbered 0 and 1, as shown in Figure 6-2. In Cisco 3640 routers, the bottom row of slots is numbered 0 and 1 and the top row is numbered 2 and 3, as shown in Figure 6-3.

Figure 6-2 Cisco 3620 Slot Numbers Example

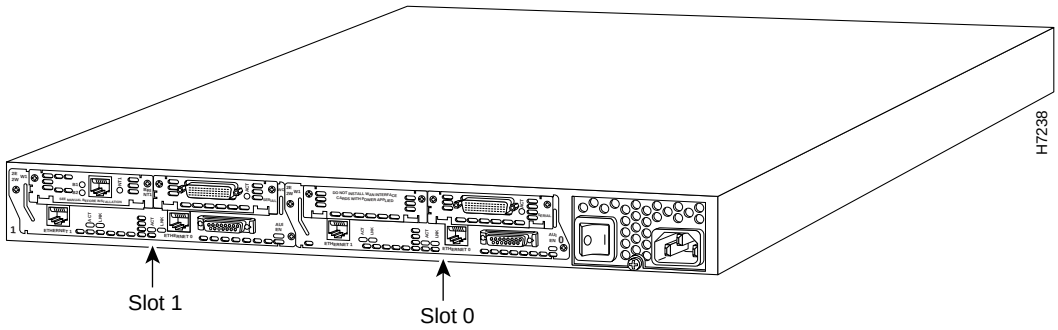
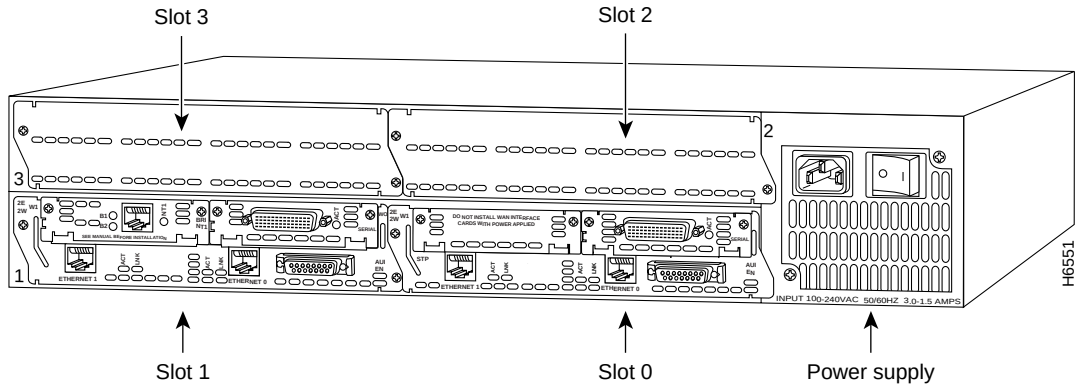


Figure 6-3 Cisco 3640 Slot Numbers Example



Ports in the 16-port and 32-port asynchronous network modules correspond to the outputs of the octal cables that connect the module to the network. These ports are numbered in the same pattern as slot numbers, beginning at 0 at the lower right and continuing from right to left and (in the 32-port module) from bottom to top. In the 16-port module, the right connector provides ports 0 to 7, and the left connector provides ports 8 to 15, as labeled on the module's rear panel. In the 32-port module, the connectors in the bottom row provide ports 0 to 7 and 8 to 15, and the connectors in the top row provide ports 16 to 23 and 24 to 31.

The interface number of a port is determined using the following:

interface-number = (32 x *slot-number*) + *unit-number* + 1

For example, asynchronous port 12 in slot 1 corresponds to interface number (32 x 1) + 12 + 1 = 45. This is also the line number for the port. Port 12 in slot 1 is always assigned interface number 45, regardless of whether the module in slot 0 is a 16-port asynchronous module, a 32-port asynchronous module, or some other type of module entirely, or even whether there is a network module in slot 0 at all. If you move the module in slot 1 to a different slot, however, its interface numbers change.

Table 6-3 shows the range of interface numbers available for each type of asynchronous network module in each Cisco 3600 series router slot. (Interface 0 is automatically assigned to the console.)

Table 6-3 Cisco 3600 Series 16-Port and 32-Port Asynchronous Network Module Interface Numbering

Slot Number	Interface Numbers (16-Port Module)	Interface Numbers (32-Port Module)
0	1–16	1–32
1	33–48	33–64
2[1]	65–80	65–96
3[1]	97–112	97–128

1 Cisco 3640 router only.

Cisco 2600 Series Asynchronous Port Interface Numbering

Interface numbering for Cisco 2600 series routers differs from Cisco 3600 series interface numbering in the following ways:

- WAN interface card slot numbers always appear as slot 0, even if the interface card is installed in the slot labeled W1.
- WAN interface cards are numbered dynamically, starting with the first card installed. For example,
  - If slot W0 is empty and slot W1 contains a 1-port serial WAN interface card, the interface number would be serial 0/0.
  - If slot W0 contains a 2-port serial WAN interface card and slot W1 contains a 1-port serial interface card, serial 0/0 and 0/1 would reside in slot W0 and serial 0/2 would reside in slot W1.

4-Port and 8-Port Interface Numbering

Existing 4-port and 8-port asynchronous/synchronous network modules, when configured for asynchronous operation under Cisco IOS releases prior to 11.2(7)P, use a different interface numbering algorithm:

interface-number = (16 x *slot-number*) + *unit-number* + 1

Table 6-4 shows the numbers available under this numbering scheme. These interface numbers create potential conflicts with the numbers assigned to 16-port and 32-port asynchronous modules: it would be possible for a 16-port or 32-port asynchronous module in one slot to overlap the interface numbers of a 4-port or 8-port asynchronous/synchronous module in another slot.

Table 6-4 4-Port and 8-Port Asynchronous Network Module Interface Numbering

Slot Number	Interface Numbers (4-Port Module)	Interface Numbers (8-Port Module)
0	1–4	1–8
1	17–20	17–24

Table 6-4 4-Port and 8-Port Asynchronous Network Module Interface Numbering (continued)

Slot Number	Interface Numbers (4-Port Module)	Interface Numbers (8-Port Module)
2[1]	33–36	33–40
3[1]	49–52	49–56

1 Cisco 3640 router only.

To prevent this conflict, Cisco IOS Release 11.2(7)P, which is required to operate 16-port and 32-port asynchronous network modules, checks when it boots for the presence of 4-port and 8-port asynchronous/synchronous network modules configured as asynchronous. If if finds any, it rewrites the starting configuration in nonvolatile random access memory (NVRAM), if necessary, to adopt the new line numbering scheme for these modules, as shown in Table 6-5.

Table 6-5 New 4-Port and 8-Port Asynchronous Network Module Interface Numbering

Slot Number	Interface Numbers (4-Port Module)	Interface Numbers (8-Port Module)
0	1–4	1–8
1	33–36	33–40
2[1]	65–68	65–72
3[1]	97–100	97–104

1 Cisco 3640 router only.

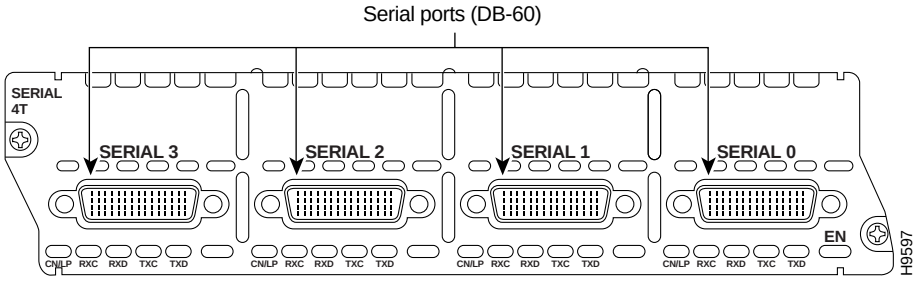
When an automatic configuration update is performed, the following message appears:

```
Line number convention changed from 16 lines/slot to 32 lines/slot.
```

4-Port Serial Network Module

This section provides information about the 4-port serial network module (Cisco product number NM-4T) for Cisco modular routers. With the appropriate serial transition cable, each port on this module can provide a EIA/TIA-232, EIA/TIA-449, V.35, X.21, DTE/DCE, EIA-530 DTE, or nonreturn to zero/nonreturn to zero inverted (NRZ/NRZI) serial interface, in any combination. The module provides a synchronous data rate of 8 MB/sec on port 0, 4 MB/sec each on port 0 and port 2, or 2 MB on all four ports simultaneously. (See Figure 6-4.)

Figure 6-4 4-Port Serial Network Module



Connecting the 4-Port Serial Module to a Network

The 4-port serial network module provides four universal high-density 60-pin receptacles. The serial cable attached to each receptacle determines the port's electrical interface type and mode, data terminal equipment (DTE) or data communications equipment (DCE).

Types of Serial Cables

Cisco Systems offers five types of serial cables (also called serial adapter cables or transition cables):

- EIA/TIA-232 Serial Cable Assembly
- EIA/TIA-449 Serial Cable Assembly

- V.35 Serial Cable Assembly
- X.21 Serial Cable Assembly
- EIA-530 Serial Cable Assembly

All serial cables provide a universal plug at the network module end. The network end of each cable provides the physical connectors most commonly used for the interface. For example, the network end of the EIA/TIA-232 serial cable is a DB-25 connector, the most widely used EIA/TIA-232 connector.

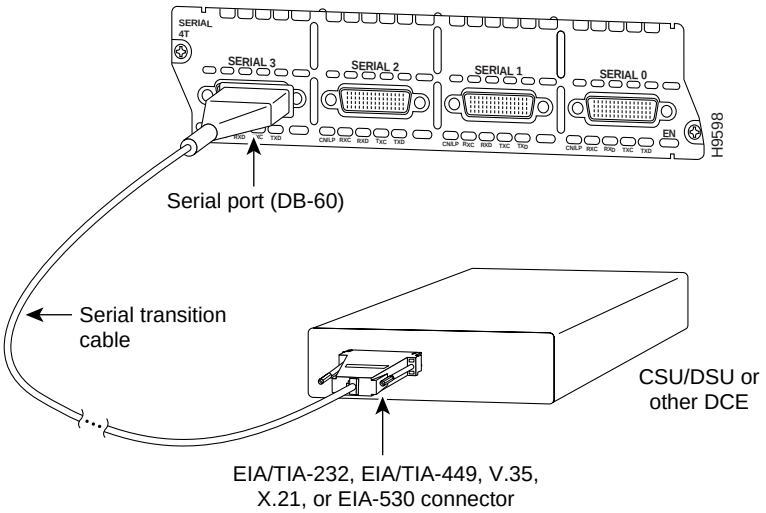
All serial interface types except EIA-530 are available in DTE or DCE format: DTE with a plug connector at the network end and DCE with a receptacle at the network end. V.35 is available in either mode with either gender at the network end. EIA-530 is available in DTE only.

Serial cables are not provided with the network module. For ordering information, see the "Cisco Connection Online" section on page xiv.

Connecting the Module to the Network

After you install a 4-port serial module, use the appropriate serial cable to connect each of the module's DB-60 serial ports to a synchronous modem, channel service unit/data service unit (CSU/DSU), or other DCE equipment. (See Figure 6-5.)

Figure 6-5 Connecting a 4-Port Serial Module to a CSU/DSU



4-Port Serial Network Module LEDs

All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

Each port on the 4-port serial network module also has the additional LEDs shown in Figure 6-6 and described in Table 6-6.

Figure 6-6 4-Port Serial Network Module LEDs

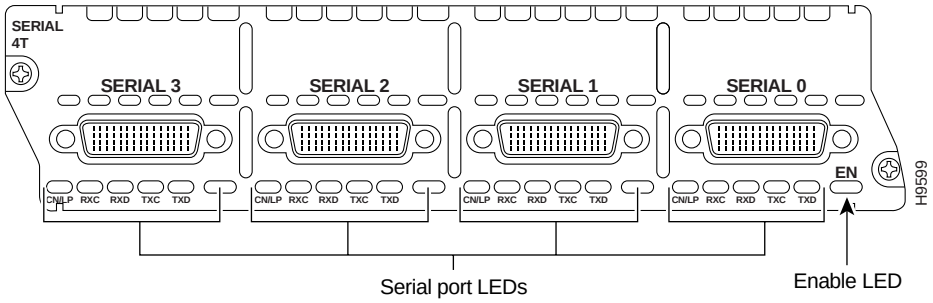


Table 6-6 4-Port Serial Network Module LEDs

LED	Meaning
CN/LP	Connect when green, loopback when yellow
RXC	Receive clock
RXD	Receive activity
TXC	Transmit clock
TXD	Transmit activity

16-Port and 32-Port Asynchronous Serial Network Module

This section provides information about the following network modules for Cisco modular routers:

- 16-port asynchronous network module—(Cisco product number NM-16A). (See Figure 6-7.)
- 32-port asynchronous network module—(Cisco product number NM-32A). (See Figure 6-8.)

When used with corresponding octal cables, these modules provide 16 or 32 EIA/TIA-232 data terminal equipment (DTE) serial interfaces. Speeds up to 134.4 kbps are supported.

Figure 6-7 16-Port Asynchronous Network Module

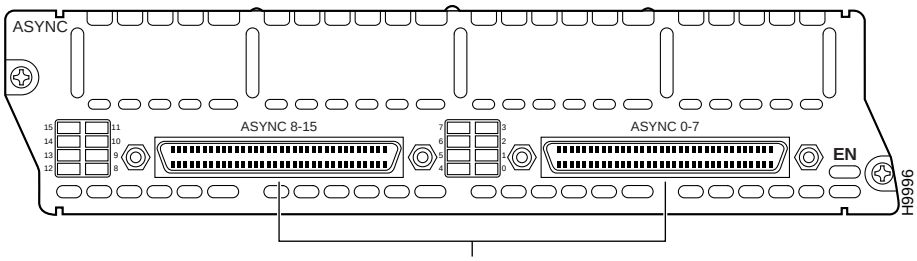
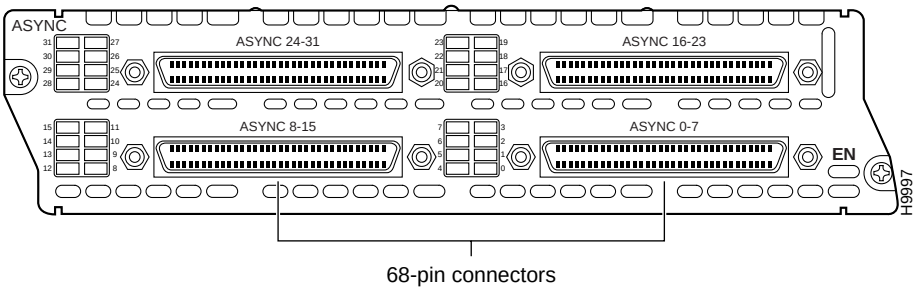


Figure 6-8 32-Port Asynchronous Network Module



Asynchronous Network Module LEDs

All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

Each port on an asynchronous network module also has a green status LED to indicate that the port is connected to the network. These LEDs are grouped in blocks of eight to the left of each module, and labeled with the port numbers. (See Figure 6-9 and Figure 6-10.)

Figure 6-9 16-Port Asynchronous Network Module LEDs

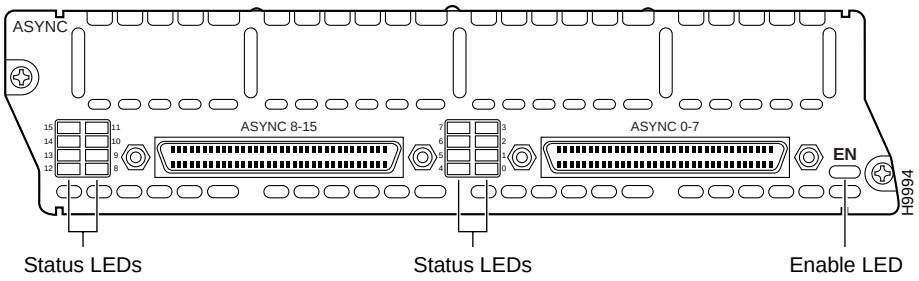
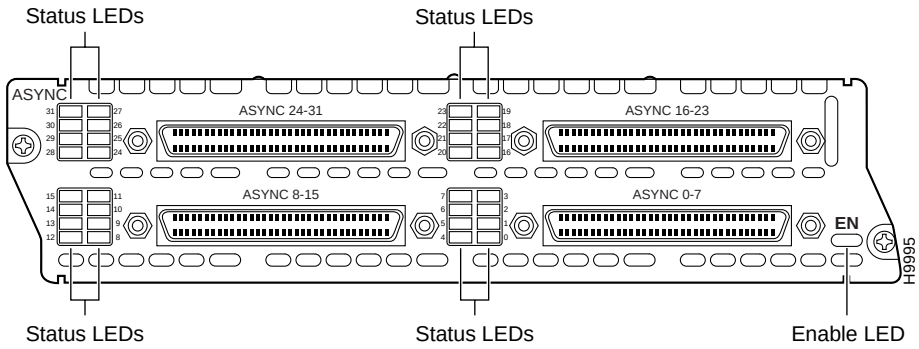


Figure 6-10 32-Port Asynchronous Network Module LEDs



4-Port and 8-Port Asynchronous/Synchronous Serial Network Module

This section provides information about the following network modules for Cisco modular routers:

- 4-port asynchronous/synchronous serial network module—(Cisco product number NM-4A/S). (See Figure 6-11.)
- 8-port asynchronous/synchronous serial network module—(Cisco product number NM-8A/S). (See Figure 6-12.)

With the appropriate serial transition cable, the ports on these modules can provide an EIA/TIA-232, EIA/TIA-449, V.35, X.21, DTE/DCE, EIA-530 DTE, or NRZ/NRZI serial interface.

Figure 6-11 4-Port Asynchronous/Synchronous Serial Network Module

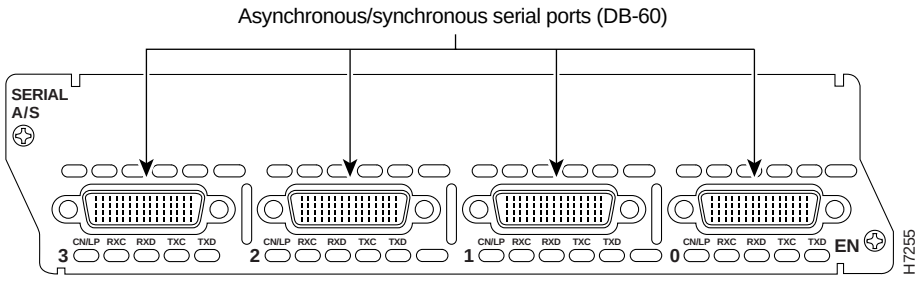
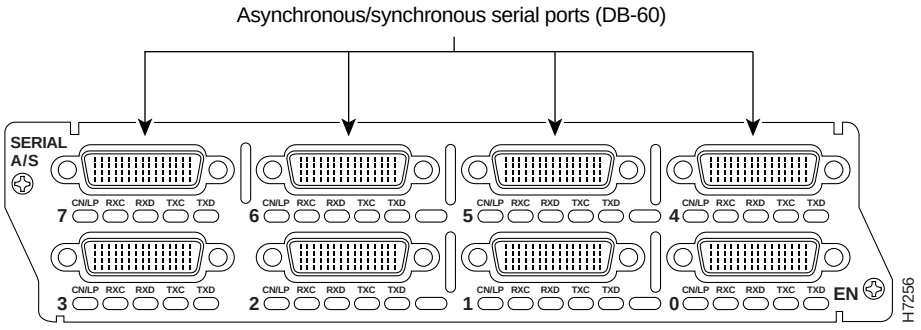


Figure 6-12 8-Port Asynchronous/Synchronous Serial Network Module



Asynchronous/Synchronous Serial Module LEDs

Figure 6-13 shows LEDs for the 4-port asynchronous/synchronous serial network module. Figure 6-14 shows LEDs for the 8-port asynchronous/synchronous serial network module.

Figure 6-13 4-Port Asynchronous/Synchronous Serial Network Module LEDs

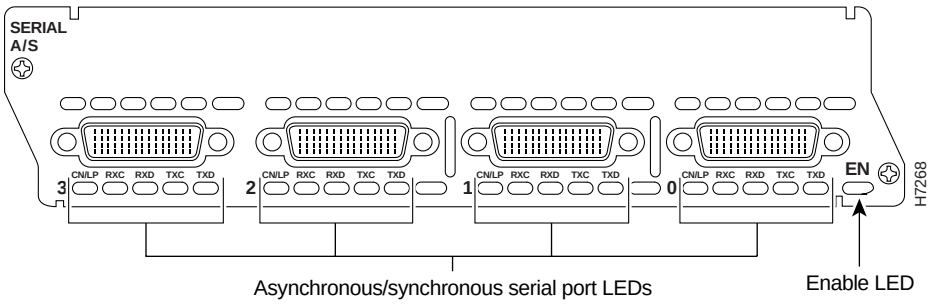
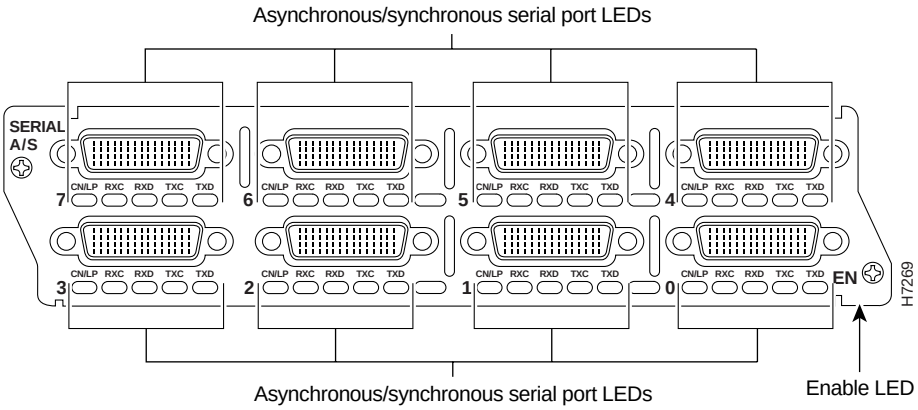


Figure 6-14 8-Port Asynchronous/Synchronous Serial Network Module LEDs



All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

Each port on an asynchronous/synchronous serial network module also has the additional LEDs shown in Table 6-7.

Table 6-7 Asynchronous/Synchronous Serial Network Module LEDs

LED	Meaning
CN/LP	Connect when green, loopback when yellow
RXC	Receive clock
RXD	Receive activity
TXC	Transmit clock
TXD	Transmit activity

CHAPTER 7

Connecting ISDN BRI Network Modules to a Network

This chapter describes how to connect Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI) network modules in Cisco modular routers, and describes the following:

- Upgrading ISDN BRI Network Modules on page 7-1
- 4-Port and 8-Port ISDN BRI S/T Network Modules on page 7-3
- 4-Port and 8-Port ISDN BRI U Network Modules on page 7-6

Unless specifically identified, references to BRI modules in this chapter include all ISDN BRI network modules.

Note Do not install an ISDN BRI network module in the same chassis as an ISDN Primary Rate Interface (PRI) network module, unless you are using Cisco IOS Release 11.3(3)T or later. Earlier Cisco IOS releases do not support this configuration.

Upgrading ISDN BRI Network Modules

If your Cisco 3600 series router contains an ISDN BRI network module (product numbers: NM-4B-S/T, NM-4B-U, NM-8B-S/T, NM-8B-U) and a digital modem network module (product numbers: NM-6DM, NM-12DM, NM-18DM, NM-24DM, NM-30DM), your ISDN BRI network module has to be upgraded to the minimum version shown in Table 7-1.

Earlier versions of the ISDN BRI network module cannot send modem calls to the digital modem network module.

Table 7-1 ISDN BRI Network Module Upgrade Versions

Module	Minimum Version
NM-4B-S/T	800-01236-03
NM-4B-U	800-01238-06
NM-8B-S/T	800-01237-03
NM-8B-U	800-01239-06

If the BRI module is the wrong revision, you see a message similar to this one when the router boots:

```
The BRI network module in slot 0 is incompatible with the digital modems
installed in the router.
```

To determine the revision level, you can examine the network module itself (outside the router), or use the Cisco IOS **show diag** command. The label on the module board should show a part number beginning with 800- and ending with -03 or -06. A BRI S/T module whose part number ends with -01 or -02 needs to be upgraded, as does a BRI U module whose part number is lower than -06.

The output of the **show diag** command looks similar to the following:

```
Port adapter is analyzed
Port adapter insertion time unknown
Hardware revision 1.0           Board revision A0
Serial number     4152626       Part number    800-01236-01
Test history      0x0           RMA number     00-00-00
EEPROM format version 1
EEPROM contents (hex):
  0x20: 01 26 01 00 00 3F 5D 32 50 04 CC 01 00 00 00 00
  0x30: 50 00 00 00 96 11 04 17 FF FF FF FF FF FF FF FF
```

To order network module upgrades, see the “Cisco Connection Online” section on page xiv.

4-Port and 8-Port ISDN BRI S/T Network Modules

This section provides information about the following network modules for Cisco modular routers:

- 4-port ISDN BRI network module—(Cisco product number NM-4B-S/T or CPANM-4B-S/T). Connects to an ISDN WAN through an external Network Termination 1 (NT1) device (also known as an S/T interface). (See Figure 7-1.) This module is also referred to as the 4-port BRI S/T network module.
- 8-port ISDN BRI network module—(Cisco product number NM-8B-S/T or CPANM-8B-S/T). Connects to an ISDN WAN through an external NT1 device (also known as an S/T interface). (See Figure 7-2.) This module is also referred to as the 8-port BRI S/T network module.

Figure 7-1 4-Port ISDN BRI Network Module (S/T Interface)

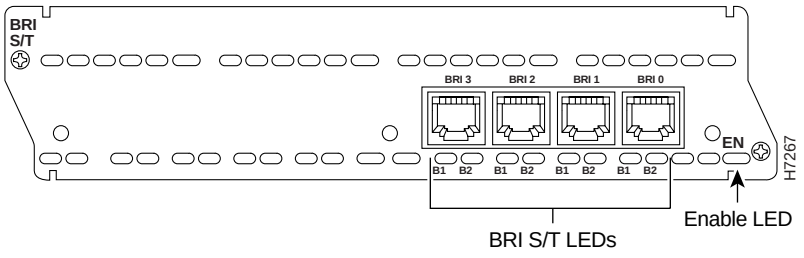
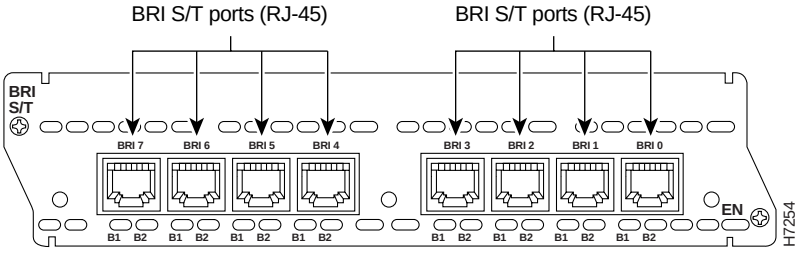


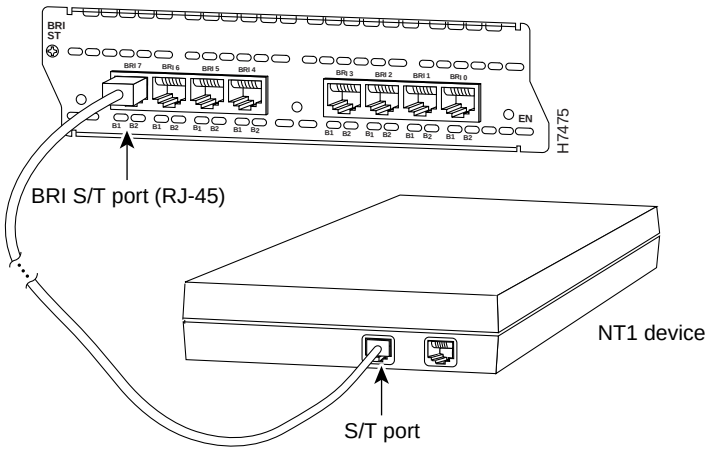
Figure 7-2 8-Port ISDN BRI Network Module (S/T Interface)



Connecting BRI S/T Modules to a Network

To connect a BRI S/T network module to a network, use a straight-through RJ-45-to-RJ-45 cable to connect the ISDN BRI port to an NT1. (See Figure 7-3.)

Figure 7-3 Connecting an ISDN BRI S/T Network Module to an NT1



BRI S/T Module LEDs

Figure 7-4 shows LEDs for the 4-port BRI S/T network module, and Figure 7-5 shows LEDs for the 8-port BRI S/T network module.

Figure 7-4 4-Port ISDN BRI S/T Network Module LEDs

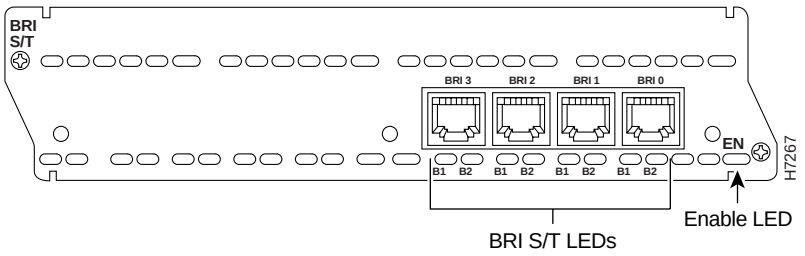
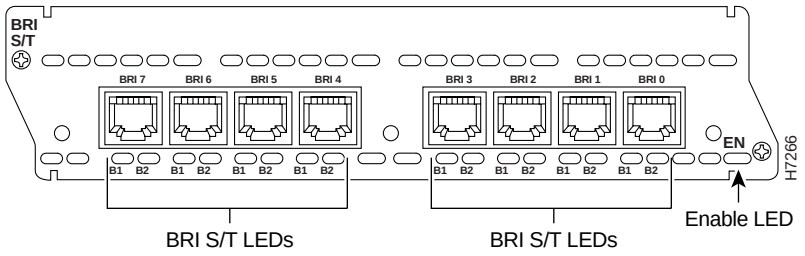


Figure 7-5 8-Port ISDN BRI S/T Network Module LEDs



All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

In addition, BRI S/T modules have two LEDs for each port. These LEDs indicate call activity on the two ISDN BRI B channels, as listed in Table 7-2.

Table 7-2 BRI S/T Network Module LEDs

LED	Meaning
B1	Call active on B1 channel
B2	Call active on B2 channel

4-Port and 8-Port ISDN BRI U Network Modules

This section provides information about the following network modules for Cisco modular routers:

- 4-port ISDN BRI with NT1 network module—(Cisco product number NM-4B-U or CPANM-4B-U). Connects to an ISDN WAN using a built-in NT1 device (also known as a U interface). (See Figure 7-6.) This module is also referred to as the 4-port BRI U network module.
- 8-port ISDN BRI with NT1 network module—(Cisco product number NM-8B-U or CPANM-8B-U). Connects to an ISDN WAN using a built-in NT1 device (also known as a U interface). (See Figure 7-7.) This module is also referred to as the 8-port BRI U network module.

Figure 7-6 4-Port ISDN BRI with NT1 Network Module (U Interface)

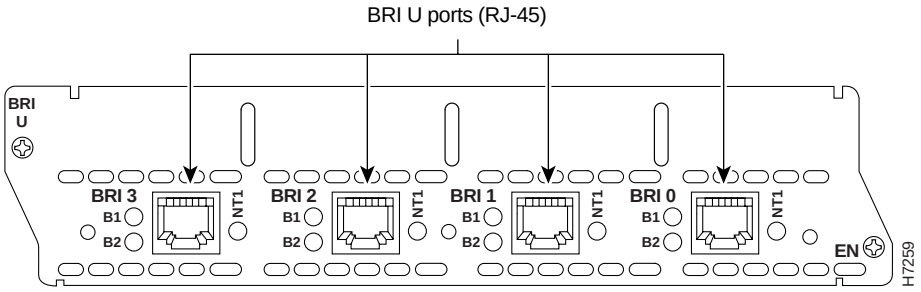
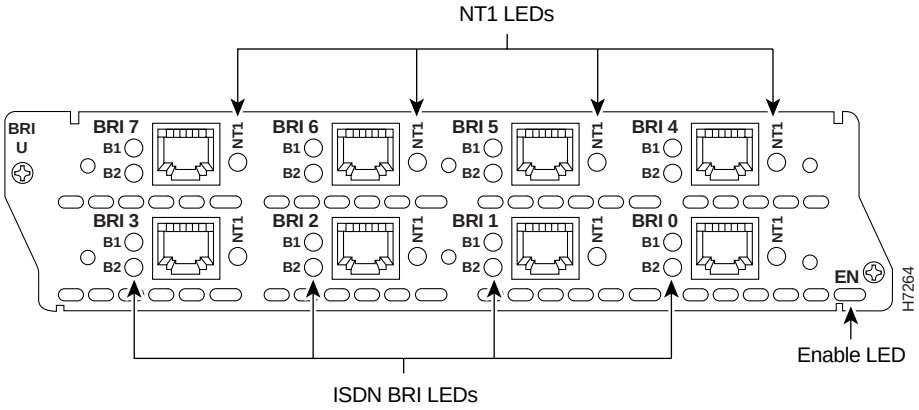


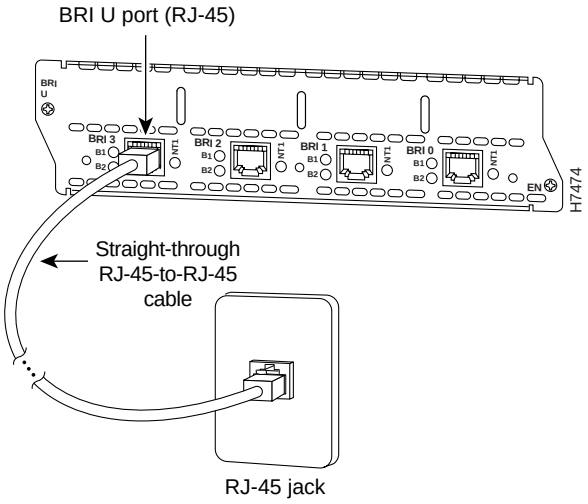
Figure 7-7 8-Port ISDN BRI with NT1 Network Module (U Interface)



Connecting BRI U Modules to a Network

To connect a BRI U module to a network, use a straight-through RJ-45-to-RJ-45 cable to connect the ISDN BRI port to an RJ-45 jack. (See Figure 7-8.)

Figure 7-8 Connecting a BRI U Network Module to an RJ-45 ISDN Jack



BRI U Modules LEDs

Figure 7-9 shows LEDs for the 4-port BRI U network module, and Figure 7-10 shows LEDs for the 8-port BRI U network module.

Figure 7-9 4-Port ISDN BRI U Network Module LEDs

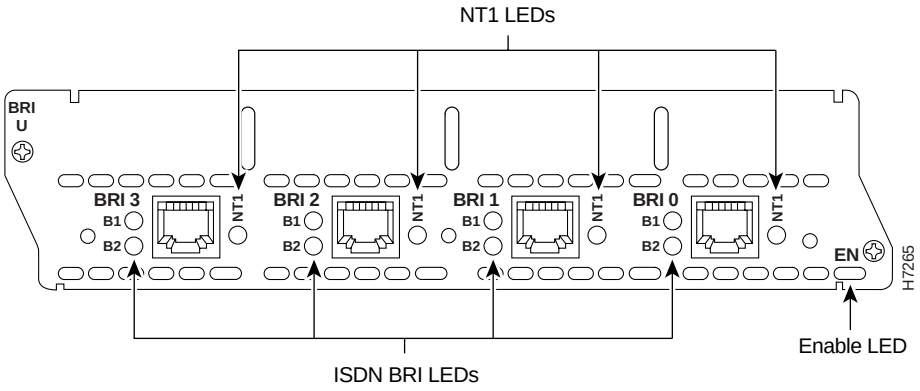
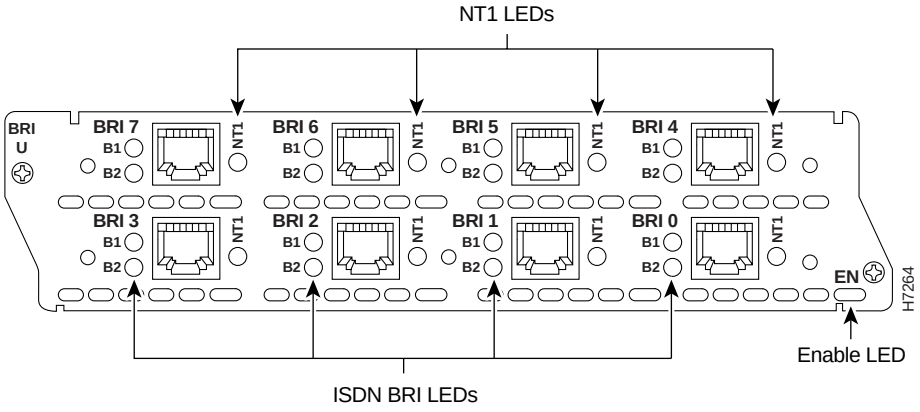


Figure 7-10 8-Port ISDN BRI U Network Module LEDs



All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

In addition, BRI U modules have three LEDs for each port. Two of these LEDs indicate call activity on the two ISDN BRI B channels, as listed in Table 7-3. The third LED, labeled NT1, indicates synchronization status of the NT1.

Table 7-3 BRI U Network Modules LEDs

LED	Meaning
B1	Activity on B1 channel
B2	Activity on B2 channel
NT1	Synchronous status of NT1

CHAPTER 8

Connecting ISDN PRI Network Modules to a Network

This chapter describes how to connect Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI) network modules used in Cisco modular routers, and describes the following modules:

- 1-Port and 2-Port Channelized T1/ISDN PRI Network Modules on page 8-2
- 1-Port and 2-Port Channelized T1/ISDN PRI with CSU Network Modules on page 8-5
- 1-Port and 2-Port Channelized E1/ISDN PRI Balanced (120-ohm) Network Modules on page 8-9
- 1-Port and 2-Port Channelized E1/ISDN PRI Unbalanced (75-ohm) Network Modules on page 8-14

Unless specifically identified, references to PRI modules in this chapter include all these network modules.

Note Do not install an ISDN Basic Rate Interface (BRI) network module in the same chassis as an ISDN PRI network module, unless you are using Cisco IOS Release 11.3(3)T or later. Earlier Cisco IOS releases do not support this configuration.

CT1/PRI modules are available with or without a built-in channel service unit (CSU) and with one or two ports. The CT1/PRI modules connect to an external CSU, whereas the CT1/PRI-CSU modules connect directly to the network. Each T1 module provides up to 24 virtual channels per T1 port, and each virtual channel is presented to the system as a serial interface that can be configured individually. The T1 interface is the physical medium that supports ISDN PRI.

The CT1/PRI and CT1/PRI-CSU modules receive and transmit data bidirectionally at the T1 rate of 1.544 Mbps.

1-Port and 2-Port Channelized T1/ISDN PRI Network Modules

This section provides information about the following network modules for Cisco modular routers:

- 1-port channelized T1/ISDN PRI network module—(Cisco product number NM-1CT1 or CPANM-1CT1). (See Figure 8-1.) This module is also referred to as the 1-port CT1/PRI network module.
- 2-port channelized T1/ISDN PRI network module—(Cisco product number NM-2CT1 or CPANM-2CT1). (See Figure 8-2.) This module is also referred to as the 2-port CT1/PRI network module.

Figure 8-1 1-Port Channelized T1/ISDN PRI Network Module

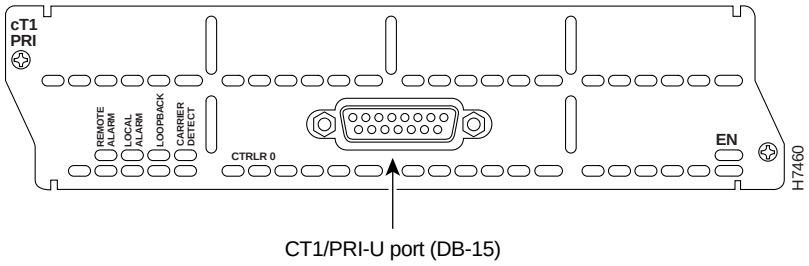
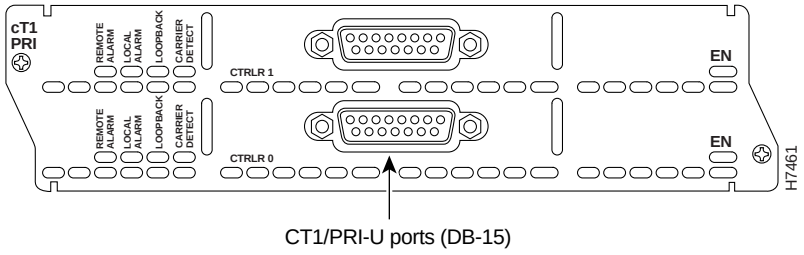


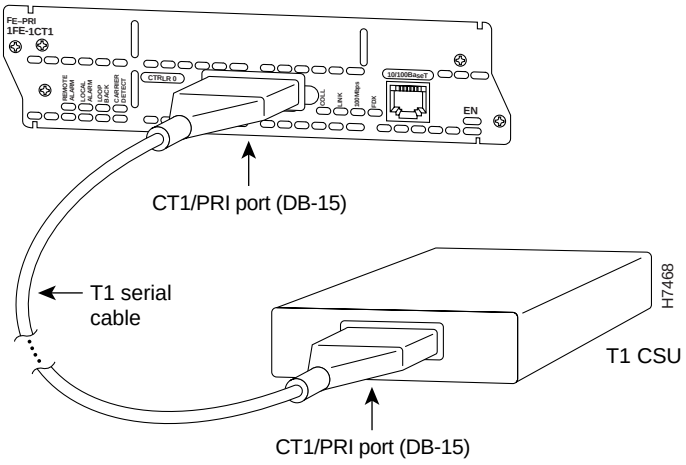
Figure 8-2 2-Port Channelized T1/ISDN PRI Network Module



Connecting CT1/PRI Modules to the Network

To connect a CT1/PRI module to the network, use a DB-15-to-DB-15 T1 serial cable to connect the CT1/PRI port to a T1 channel service unit (CSU). (See Figure 8-3.)

Figure 8-3 Connecting a CT1/PRI Module to a T1 CSU



CT1/PRI Module LEDs

Figure 8-4 and Figure 8-5 show CT1/PRI network module LEDs.

Figure 8-4 1-Port CT1/PRI Network Module LEDs

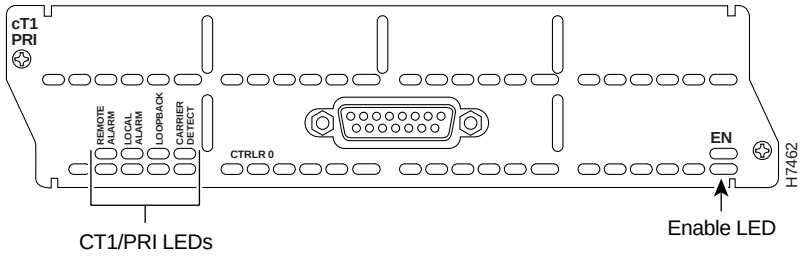
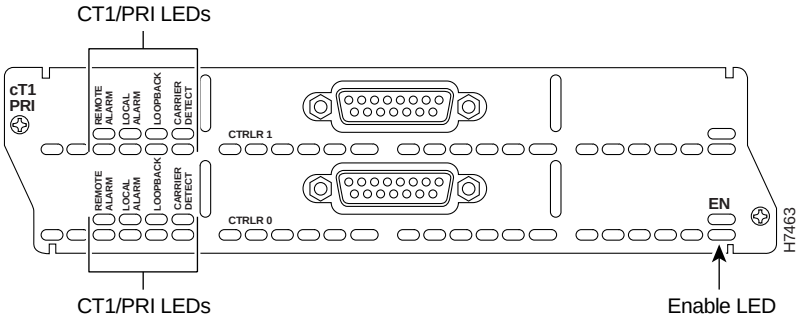


Figure 8-5 2-Port CT1/PRI Network Module LEDs



All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

All PRI modules display four additional LEDs for each port. These LEDs are described in Table 8-1.

Table 8-1 ISDN PRI Network Module LEDs

LED	Meaning
REMOTE ALARM	Local alarm at remote end of connection
LOCAL ALARM	Loss of signal, loss of frame, or unavailability because of excessive errors
LOOPBACK	Controller local loopback
CARRIER DETECT	Carrier received on telco link

1-Port and 2-Port Channelized T1/ISDN PRI with CSU Network Modules

This section provides information about the following network modules for Cisco modular routers:

- 1-port channelized T1/ISDN PRI with CSU network module—(Cisco product number NM-1CT1-CSU or CPANM-1CT1-CSU). (See Figure 8-6.) This module is also referred to as the 1-port CT1/PRI CSU network module.
- 2-port channelized T1/ISDN PRI with CSU network module—(Cisco product number NM-2CT1-CSU or CPANM-2CT1-CSU). (See Figure 8-7.) This module is also referred to as the 2-port CT1/PRI CSU network module.

Figure 8-6 1-Port Channelized T1/ISDN PRI with CSU Network Module

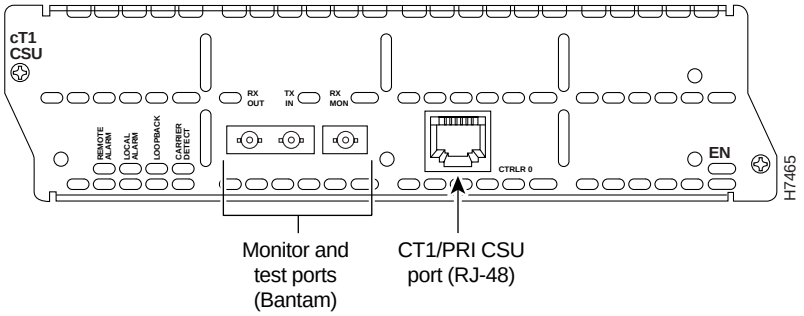
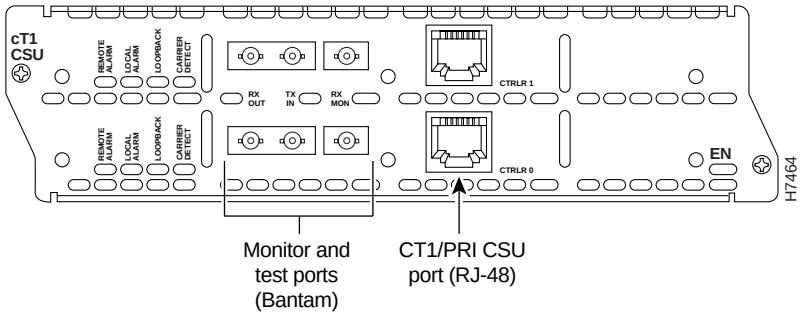


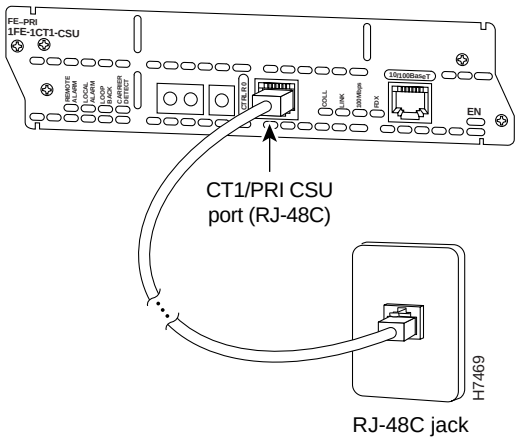
Figure 8-7 2-Port Channelized T1/ISDN PRI with CSU Network Module



Connecting CT1/PRI CSU Modules to the Network

To connect a CT1/PRI CSU module to the network, use a straight-through RJ-48C-to-RJ-48C cable to connect the RJ-48C port to an RJ-48C jack. (See Figure 8-8.)

Figure 8-8 Connecting a CT1/PRI CSU Module to an RJ-48C Jack



CT1/PRI CSU Module LEDs

Figure 8-9 and Figure 8-10 show CT1/PRI CSU module LEDs.

Figure 8-9 1-Port CT1/PRI CSU Network Module LEDs

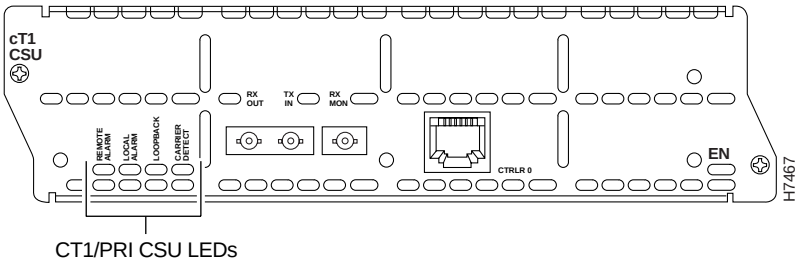
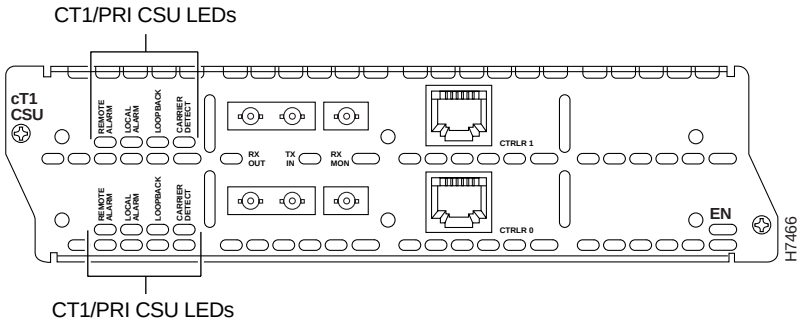


Figure 8-10 2-Port CT1/PRI CSU Network Module LEDs



All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

All PRI modules display four additional LEDs for each port. These LEDs are described in Table 8-2.

Table 8-2 ISDN PRI Network Module LEDs

LED	Meaning
REMOTE ALARM	Local alarm at remote end of connection
LOCAL ALARM	Loss of signal, loss of frame, or unavailability because of excessive errors
LOOPBACK	Controller local loopback
CARRIER DETECT	Carrier received on telco link

1-Port and 2-Port Channelized E1/ISDN PRI Balanced (120-ohm) Network Modules

This section provides information about the following network modules for Cisco modular routers:

- 1-port channelized E1/ISDN PRI balanced (120-ohm) network module—(Cisco product number NM-1CE1B or CPANM-1CE1B). (See Figure 8-11.) This module is also referred to as the 1-port CE1/PRI-B network module.
- 2-port channelized E1/ISDN PRI balanced (120-ohm) network module—(Cisco product number NM-2CE1B or CPANM-2CE1B). (See Figure 8-12.) This module is also referred to as the 2-port CE1/PRI-B network module.

Figure 8-11 1-Port Channelized E1/ISDN PRI Network Module (Balanced)

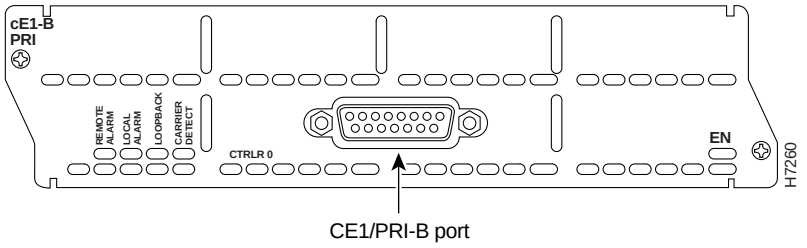
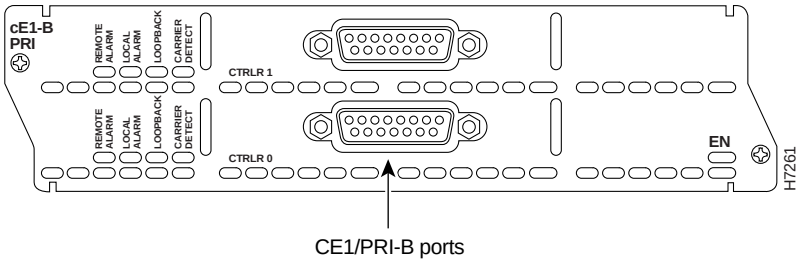


Figure 8-12 2-Port Channelized E1/ISDN PRI Network Module (Balanced)



The CE1/PRI modules are available with one or two E1 ports and with balanced or unbalanced interfaces. CE1/PRI modules receive and transmit data bidirectionally at the E1 rate of 2.048 Mbps and provide up to 30 virtual channels per E1 port. Each of the virtual channels is presented to the system as a serial interface that can be configured individually. The E1 interface is the physical media that supports ISDN PRI.

CE1/PRI Module Jumper Settings

Jumpers on the CE1/PRI modules can be used to connect or disconnect receive shield to ground. (See Table 8-3.) The default setting for balanced, 120-ohm CE1/PRI-B modules disconnects receive shield to ground. The default setting for unbalanced, 75-ohm CE1/PRI-U modules connects receive shield to ground. If you are experiencing ground loop problems with E1 cabling, you may want to try changing the jumper settings in the module.

Table 8-3 CE1/PRI Module Jumpers

CE1/PRI Module Type	Default Jumper Setting	Function
Balanced, 120 ohm	2 and 3	Disconnects receive shield from ground
Unbalanced, 75 ohm	1 and 2	Connects receive shield to ground

Connecting CE1/PRI-B Modules to the Network

To connect a CE1/PRI-B (120-ohm) module to the network, use the appropriate cable to connect the CE1/PRI-B port to an E1 CSU. (See Figure 8-13, Figure 8-14, and Figure 8-15, showing DB-15, twinax, and RJ-45 CSUs respectively.)

Figure 8-13 Connecting a 120-ohm CE1/PRI-B Module to an E1 CSU (DB-15-to-DB-15 Connectors)

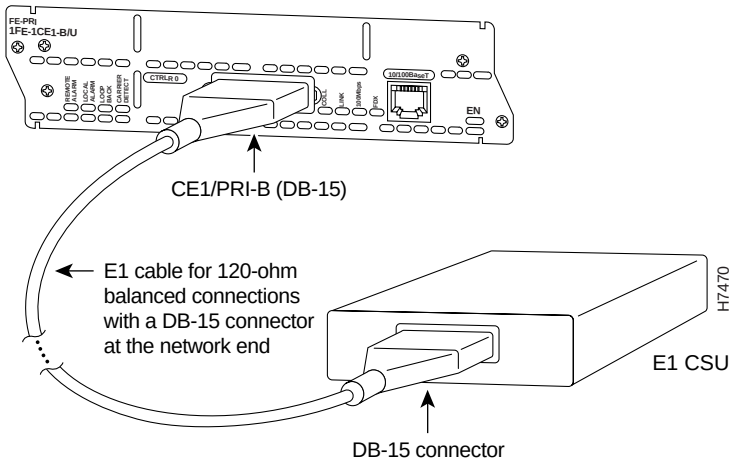


Figure 8-14 Connecting a 120-ohm CE1/PRI-B Module to an E1 CSU (DB-15-to-Twinax Connectors)

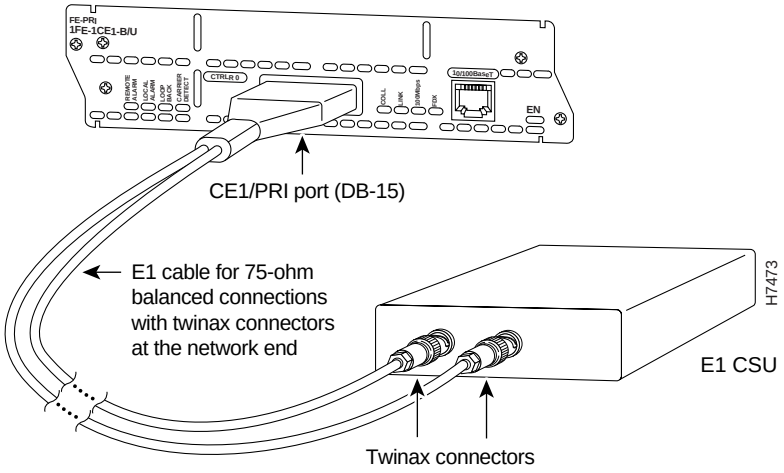
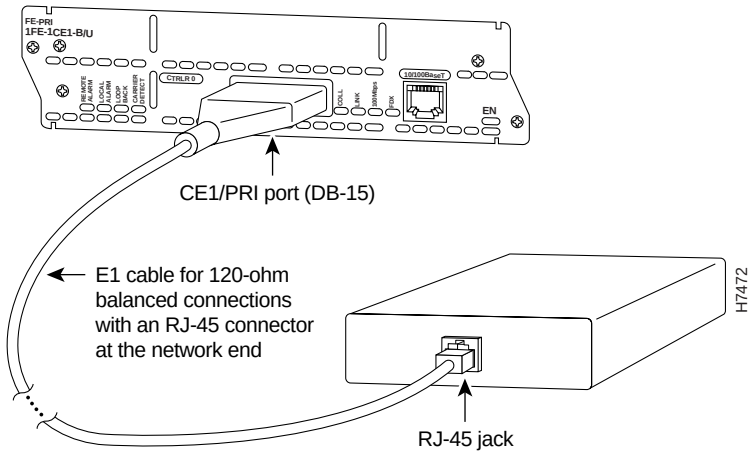


Figure 8-15 Connecting a 120-ohm CE1/PRI-B Module to an E1 CSU (DB-15-to-RJ-45 Connectors)



CE1/PRI Module LEDs

Figure 8-16 and Figure 8-17 show CE1/PRI module LEDs.

Figure 8-16 1-Port CE1/PRI Network Module LEDs

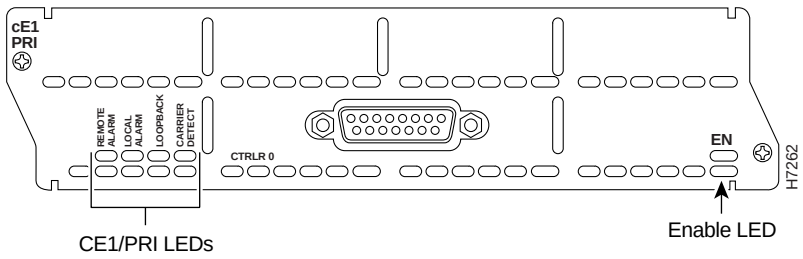
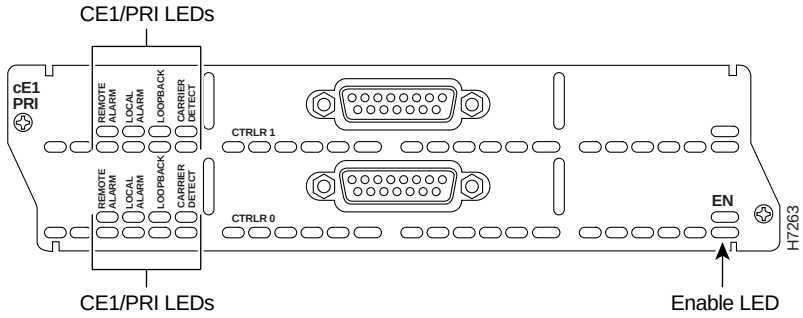


Figure 8-17 2-Port CE1/PRI Network Module LEDs



All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

All PRI modules display four additional LEDs for each port. These LEDs are described in Table 8-4.

Table 8-4 ISDN PRI Network Module LEDs

LED	Meaning
REMOTE ALARM	Local alarm at remote end of connection
LOCAL ALARM	Loss of signal, loss of frame, or unavailability because of excessive errors
LOOPBACK	Controller local loopback
CARRIER DETECT	Carrier received on telco link

1-Port and 2-Port Channelized E1/ISDN PRI Unbalanced (75-ohm) Network Modules

This section provides information about the following network modules for Cisco modular routers:

- 1-port channelized E1/ISDN PRI unbalanced (75-ohm) network module—(Cisco product number NM-1CE1U or CPANM-1CE1U). (See Figure 8-18.) This module is also referred to as the 1-port CE1/PRI-U network module.
- 2-port channelized E1/ISDN PRI unbalanced (75-ohm) network module—(Cisco product number NM-2CE1U or CPANM-2CE1U). (See Figure 8-19.) This module is also referred to as the 2-port CE1/PRI-U network module.

Figure 8-18 1-Port Channelized E1/ISDN PRI Network Module (Unbalanced)

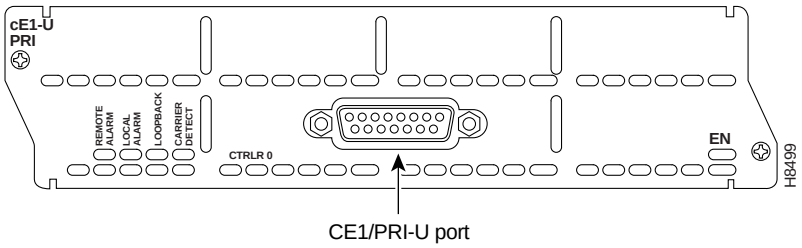
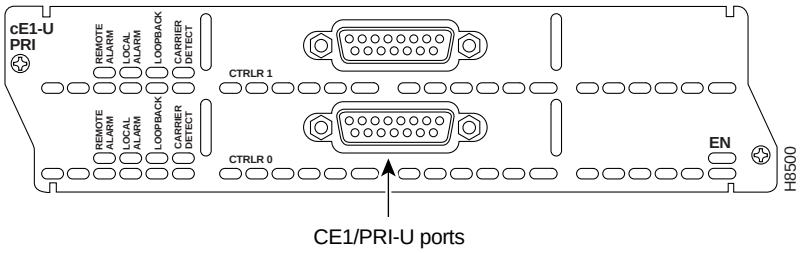


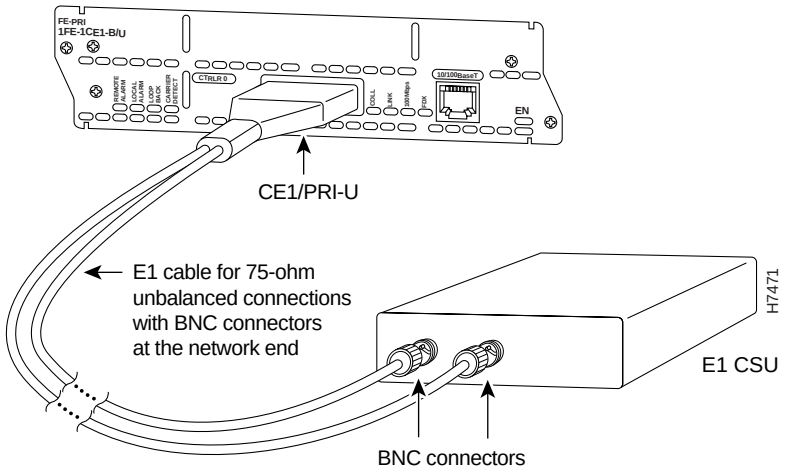
Figure 8-19 2-Port Channelized E1/ISDN PRI Network Module (Unbalanced)



Connecting CE1/PRI-U Modules to the Network

To connect a CE1/PRI-U (75-ohm) module to the network, use the appropriate cable to connect the CE1/PRI-U port to an E1 CSU. (See Figure 8-20.) The illustration shows a CSU with BNC connectors.

Figure 8-20 Connecting a CE1/PRI-U Module to an E1 CSU (DB-15-to-BNC Connectors)



CE1/PRI Module LEDs

Figure 8-21 and Figure 8-22 show CE1/PRI module LEDs.

Figure 8-21 1-Port CE1/PRI Network Module LEDs

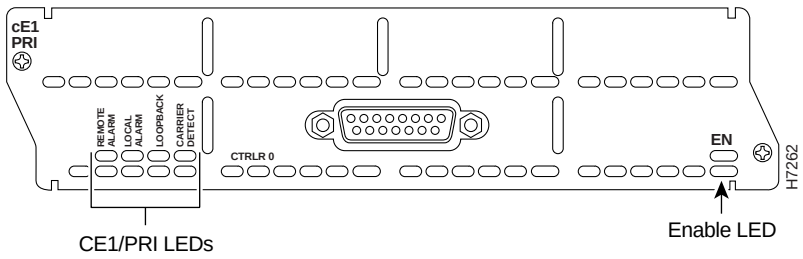
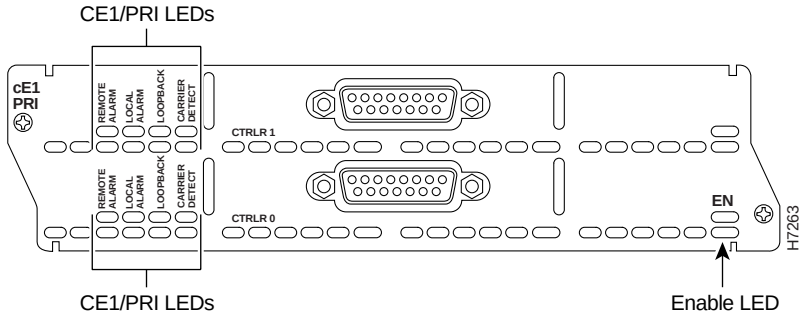


Figure 8-22 2-Port CE1/PRI Network Module LEDs



All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

All PRI modules display four additional LEDs for each port. These LEDs are described in Table 8-5.

Table 8-5 ISDN PRI Network Module LEDs

LED	Meaning
REMOTE ALARM	Local alarm at remote end of connection
LOCAL ALARM	Loss of signal, loss of frame, or unavailability because of excessive errors
LOOPBACK	Controller local loopback
CARRIER DETECT	Carrier received on telco link

CE1/PRI Module Jumper Settings

Jumpers on the CE1/PRI modules can be used to connect or disconnect receive shield to ground. (See Table 8-6.) The default setting for balanced, 120-ohm CE1/PRI-B modules disconnects receive shield to ground. The default setting for unbalanced, 75-ohm CE1/PRI-U modules connects receive shield to ground. If you are experiencing ground loop problems with E1 cabling, you may want to try changing the jumper settings in the module.

Table 8-6 CE1/PRI Module Jumpers

CE1/PRI Module Type	Default Jumper Setting	Function
Balanced, 120 ohm	2 and 3	Disconnects receive shield from ground
Unbalanced, 75 ohm	1 and 2	Connects receive shield to ground

CHAPTER 9

Connecting Voice Network Modules to a Network

Voice network modules convert telephone voice signals into a form that can be transmitted over an IP network. Voice interface cards provide the connection to the telephone equipment or network.

This chapter contains the following sections:

- 2-Channel and 4-Channel Voice Network Modules on page 9-1
- Voice Network Module LEDs on page 9-3

2-Channel and 4-Channel Voice Network Modules

This section explains how to connect 2-channel and 4-channel voice network modules—(Cisco part numbers NM-1V and NM-2V) in Cisco modular routers. (See Figure 9-1 and Figure 9-2.)

You need both a voice network module and a voice interface card for a voice connection. You can install one voice interface card in a 2-channel voice network module, and two voice interface cards in a 4-channel module. At least one other network module or WAN interface card must be installed in the router to provide the connection to the IP LAN or WAN.

WAN and voice interface cards are described in the *Cisco WAN Interface Cards Hardware Installation Guide* publication.

Figure 9-1 2-Channel Voice Network Module

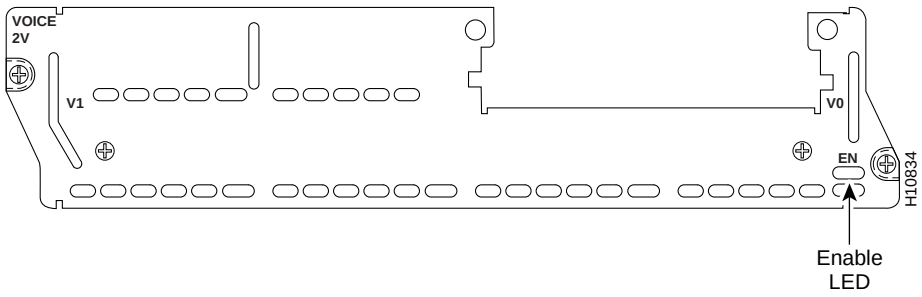
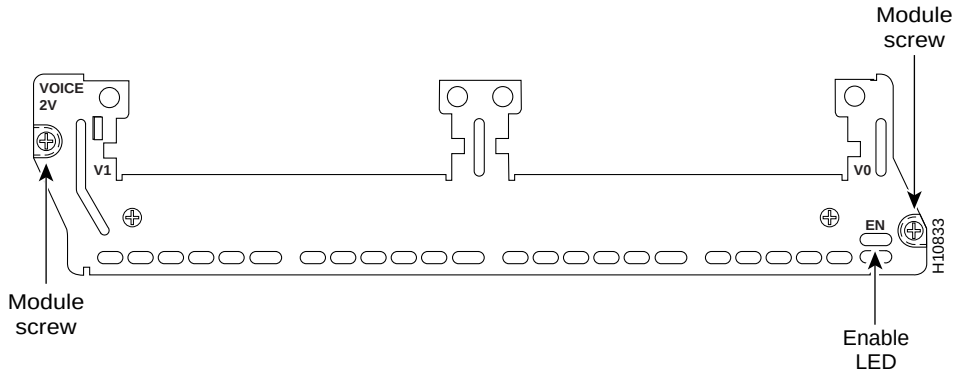


Figure 9-2 4-Channel Voice Network Module

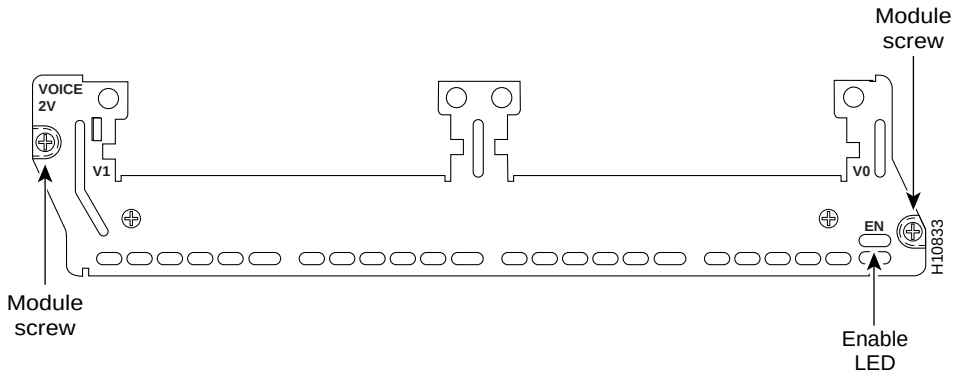


Voice network modules convert telephone voice signals into a form that can be transmitted over an IP network, and have no connectors. The voice network module (2-channel or 4-channel) determines the number of voice connections you can make through voice interface cards. Voice interface cards provide the connection to the telephone equipment or network. (See the *Cisco WAN Interface Cards Hardware Installation Guide*.)

Voice Network Module LEDs

All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router. (See Figure 9-3.)

Figure 9-3 Voice Network Module LED



CHAPTER 10

Connecting Digital Modem Network Modules to a Network

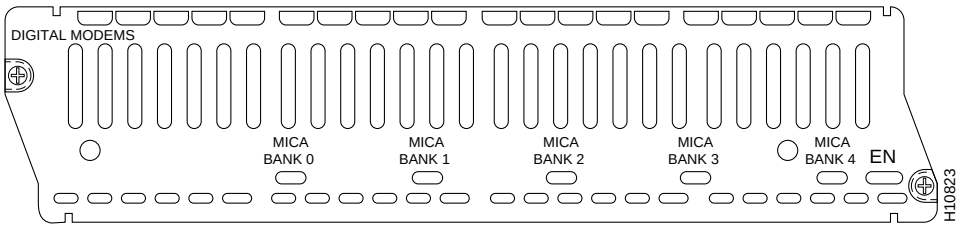
Note Digital modem network modules are supported in Cisco 3600 series routers only.

This chapter contains the following sections:

- Hardware Requirements on page 10-3
- Interface Numbering on page 10-4
- Adding 6-Port MICA Modules to a Digital Modem Network Module on page 10-6
- Digital Modem Module LEDs on page 10-16

These sections describe how to connect 6-, 12-, 18-, 24-, and 30-port digital modem network modules (Cisco product numbers NM-6DM, NM-12DM, NM-18DM, NM-24DM, NM-30DM) for Cisco modular routers. (See Figure 10-1.) These modules contain 6, 12, 18, 24, or 30 V.34+ digital modems for a direct digital connection to an Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI) or Basic Rate Interface (BRI) channel, allowing you to mix digital and analog calls to provide remote access to a LAN.

Figure 10-1 Digital Modem Network Module



Digital modem network modules do not provide network interfaces of their own, but instead handle analog calls passing through other router interfaces. In addition to the digital modem module, the router must contain a PRI or BRI network module to connect to the ISDN channel, and another module, such as Ethernet, to provide connectivity to the LAN. The PRI or BRI module concurrently handles digital ISDN data connections and remote voice-channel (analog) modem connections, allowing a dynamic mix of digital and modem connections. The digital modem module acts as a pool of available modems that can be used for both incoming and outgoing calls.

Caution Digital modem network modules require Cisco IOS Release 11.2(9)XA or 11.2(10)P or later. The PRI module must be hardware revision -03; the BRI S/T module must be hardware revision -03, and the BRI U module must be hardware revision -06. Earlier revisions of these network modules are incompatible with digital modem modules.

The digital modems support all standard data rates from 300 bps through 33.6 kbps (V.34 bis); V.42 bis and MNP 5 data compression; and V.42, LAPM, and MNP 4 error correction.

Each digital modem module contains from one to five banks of 6-port modem ISDN channel aggregation (MICA) modules. You can add modems to a module, in groups of six, by installing additional MICA modules (Cisco product number MICA-6MOD=), up to a maximum of 30 modems.

Hardware Requirements

In addition to the digital modem module, the router must contain a PRI or BRI network module to connect to the ISDN channel, and another module, such as Ethernet, to provide connectivity to the LAN.

Note The PRI module (Cisco product number NM-1CT1, NM-2CT1, NM-1CT1-CSU, NM-2CT1-CSU, NM-1CE1B, NM-2CE1B, NM-1CE1U, or NM-2CE1U) must be revision level -03.

The BRI S/T module with Cisco part number NM-4B-S/T or NM-8B-S/T must be revision level -03, and the BRI U module with Cisco product number NM-4B-U or NM-8B-U must be revision level -06.

If the PRI or BRI module is the wrong revision, you see a message similar to this one when the router boots:

```
The T1 or E1 network module in slot 0 is incompatible with the digital
modems installed in the router.
```

To determine the revision level, you can examine the network module itself (outside the router), or use the Cisco IOS **show diag** command. The label on the module board should show a part number beginning with 800- and ending with -03 or -06. A PRI or BRI S/T module whose part number ends with -01 or -02 needs to be upgraded, as does a BRI U module whose part number is lower than -06.

The output of the **show diag** command looks similar to the following:

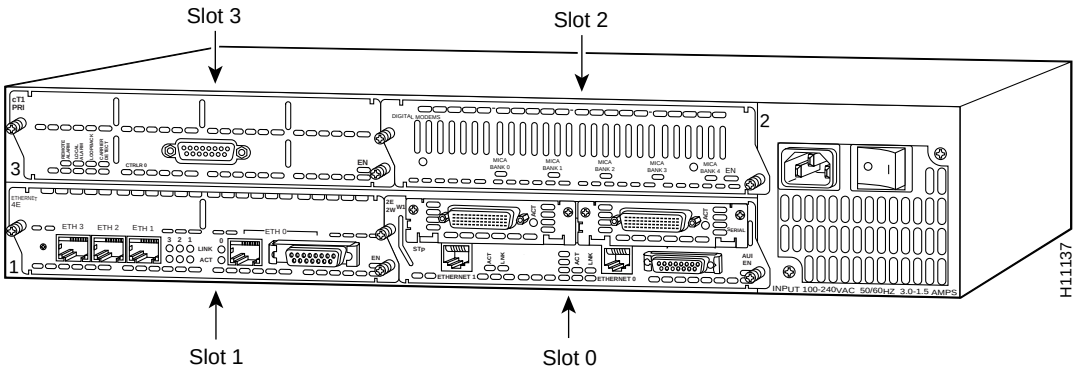
```
Slot 3:
        CT1 (CSU) port adapter, 1 port
        Port adapter is analyzed
        Port adapter insertion time unknown
        Hardware revision 1.0           Board revision A0
        Serial number     4152626       Part number    800-01228-01
        Test history      0x0           RMA number     00-00-00
        EEPROM format version 1
        EEPROM contents (hex):
          0x20: 01 26 01 00 00 3F 5D 32 50 04 CC 01 00 00 00 00
          0x30: 50 00 00 00 96 11 04 17 FF FF FF FF FF FF FF FF
```

Interface Numbering

Individual digital modem ports are not physically distinct, but Cisco IOS software identifies each modem uniquely through its slot number and a port number.

In Cisco 3600 series routers, slot numbers begin at 0 at the bottom right of the chassis, as viewed from the rear. In Cisco 3640 routers, the bottom row of slots is numbered 0 and 1 and the top row is numbered 2 and 3, as shown in Figure 10-2.

Figure 10-2 Cisco 3640 Slot Numbers



Each digital modem module can hold up to five banks of MICA modules, numbered 0 to 4 from left to right (as viewed from the rear of the router). Each MICA module holds six modems, which are assigned modem numbers 0 to 5.

Each modem in a digital modem module is also assigned a port number in the range 0 to 29. Modems in the left MICA module (as viewed from the rear of the router), bank 0, are assigned port numbers 0 to 5. Additional MICA modules, if present, are assigned the port numbers shown in Table 10-1.

Table 10-1 MICA Module Port Numbers

MICA Bank	Port Numbers
0 (left)	0–5
1	6–11
2	12–17
3	18–23
4 (right)	24–29

This relation can be expressed as:

port-number = (6 x *bank-number*) + *modem-number*

For example, the third modem (modem 2) in the second MICA module from the left (bank 1) is assigned port number (6 x 1) + 2 = 8.

Some Cisco IOS commands identify ports by interface number (or line number or TTY number, which are the same as the interface number) rather than slot and port number. The interface number of a modem port is related to its slot and port number in the following way:

interface-number = (32 x *slot-number*) + *port-number* + 1

This can also be expressed as:

interface-number = (32 x *slot-number*) + ((6 x *bank-number*) + *modem-number*) + 1

For example, if the module containing the modem in the last example is placed in slot 2, the modem is assigned interface number (32 x 2) + ([6 x 1] + 2) + 1 = (32 x 2) + 8 + 1 = 73. This is also the line and TTY number for the port. The modem in this position is always assigned interface 73, whether or not there are other MICA modules in the digital modem network module or other digital modem network modules in the router chassis. If you move the MICA module to a different position in the digital modem network module, however, or move the digital modem network module to a different slot in the router chassis, the interface number changes.

Table 10-2 shows the range of interface numbers available in each router slot. Interface 0 is automatically assigned to the console.

Table 10-2 Digital Modem Network Module Interface Numbering

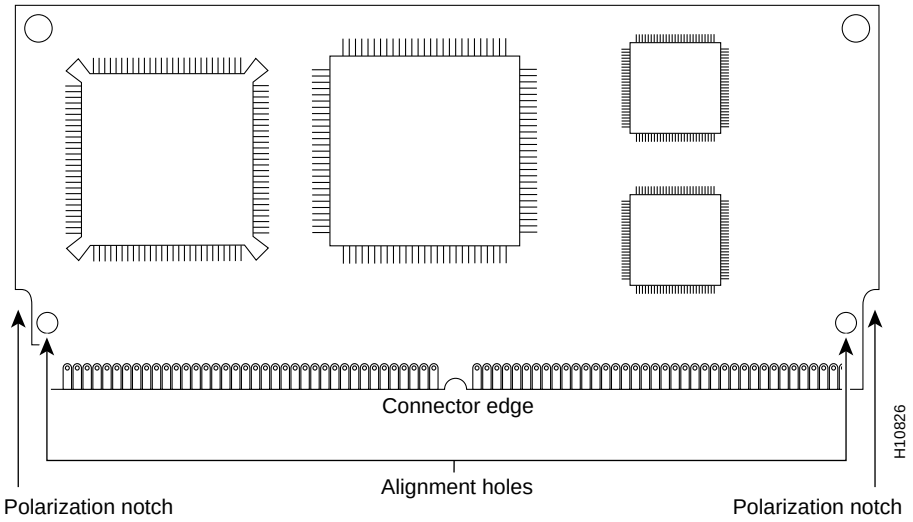
Slot Number	Interface Numbers
0	1–30
1	33–62
2	65–94
3	97–126

Adding 6-Port MICA Modules to a Digital Modem Network Module

You can add modems to a digital modem network module, in groups of six, by installing additional 6-port MICA modules, up to a maximum of five MICA modules (30 modems).

MICA modules are manufactured with a polarization notch to ensure proper orientation, and alignment holes that fit over guide posts to ensure proper positioning. (See Figure 10-3.)

Figure 10-3 6-Port MICA Module



Caution To avoid damaging electrostatic discharge (ESD)-sensitive components, observe all ESD precautions when handling MICA modules. To avoid damaging the network module or the MICA module, avoid excessive force when you remove or replace MICA modules.

To remove, replace, or install a MICA module, you must first remove the digital modem module from the router chassis.

Removing the Digital Modem Network Module

Caution Network modules do not support online insertion and removal (hot swap). To avoid damaging the module, before you remove a network module from a chassis slot, you must turn OFF electrical power and disconnect network cables.

Follow this procedure to remove a digital modem network module:

Step 1 Turn OFF electrical power to the router. However, to channel ESD voltages to ground, do not unplug the power cable. Remove all network interface cables, including telephone cables, from the rear panel.

The following warning applies to routers that use a DC power supply:

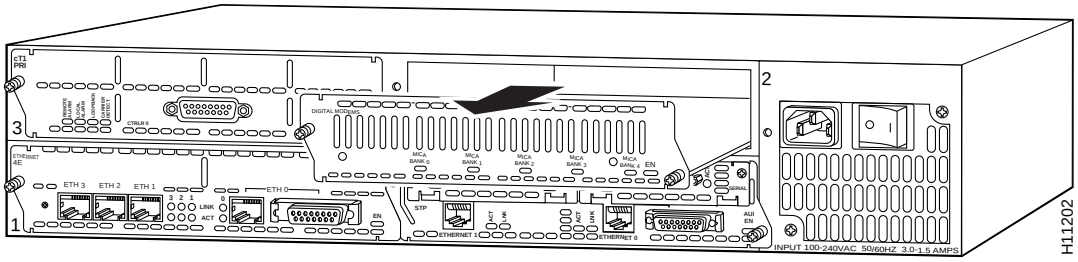
Warning Before performing any of the following procedures, ensure that power is removed from the DC circuit. To ensure that all power is OFF, locate the circuit breaker on the panel board that services the DC circuit, switch the circuit breaker to the OFF position, and tape the switch handle of the circuit breaker in the OFF position.

Step 2 Loosen the module's captive mounting screws, using a Phillips or flat-blade screwdriver.

Step 3 Hold the captive screws between two fingers, and pull the network module toward you until it slides free of the chassis. (See Figure 10-4.)

Step 4 Set the network module on an ESD-preventive mat.

Figure 10-4 Removing a Digital Modem Network Module from a Router



Removing 6-Port MICA Modules

To remove a MICA module from the digital modem network module, follow these steps:

Step 1 Orient the digital modem network module so that the faceplate is on the right.

Caution Handle MICA modules by the card edges only. MICA modules are ESD-sensitive components and can be damaged by mishandling.

Step 2 Remove one MICA module at a time, beginning with the one farthest from you.

Step 3 To lift the MICA module out of its socket, pull the spring clips on both sides outward (see Figure 10-5) and tilt the MICA module away from you until it is free of the clips (see Figure 10-6).

Step 4 Hold the MICA module by the edges with your thumb and index finger and lift it out of the socket. (See Figure 10-7.) Place the removed MICA module in an antistatic bag to protect it from ESD damage.

Step 5 Repeat Step 2 through Step 4 for any remaining MICA modules that you want to remove.

Figure 10-5 Releasing the Mounting Clips

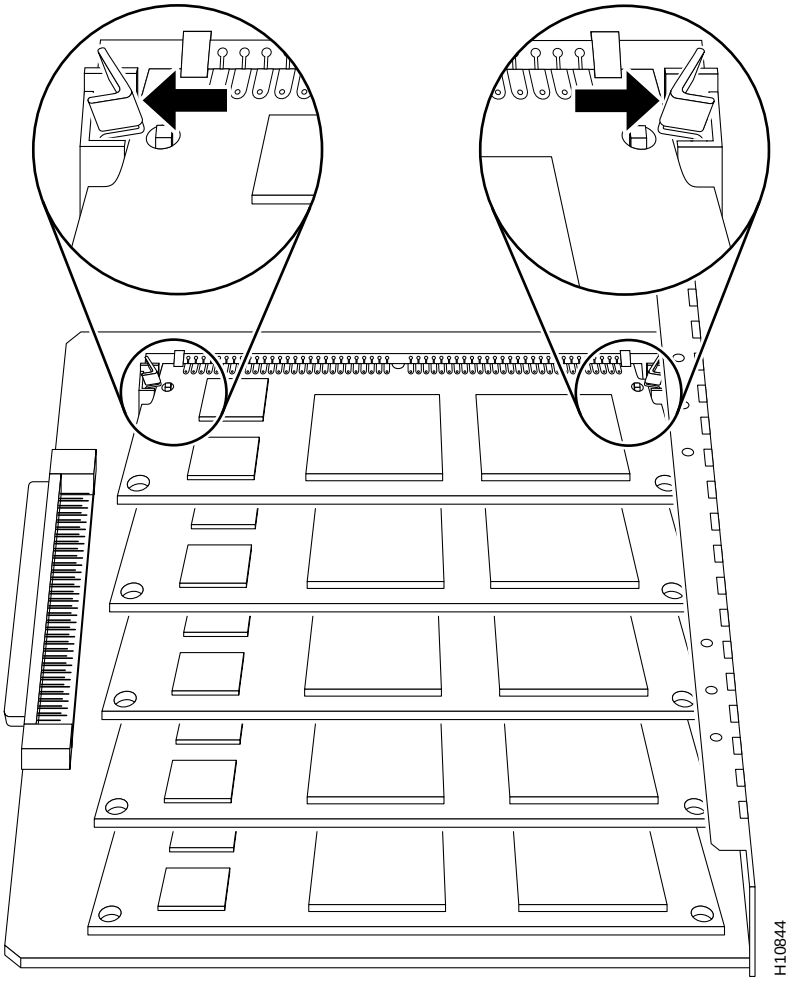


Figure 10-6 Tilting a 6-Port MICA Module Free of the Mounting Clips

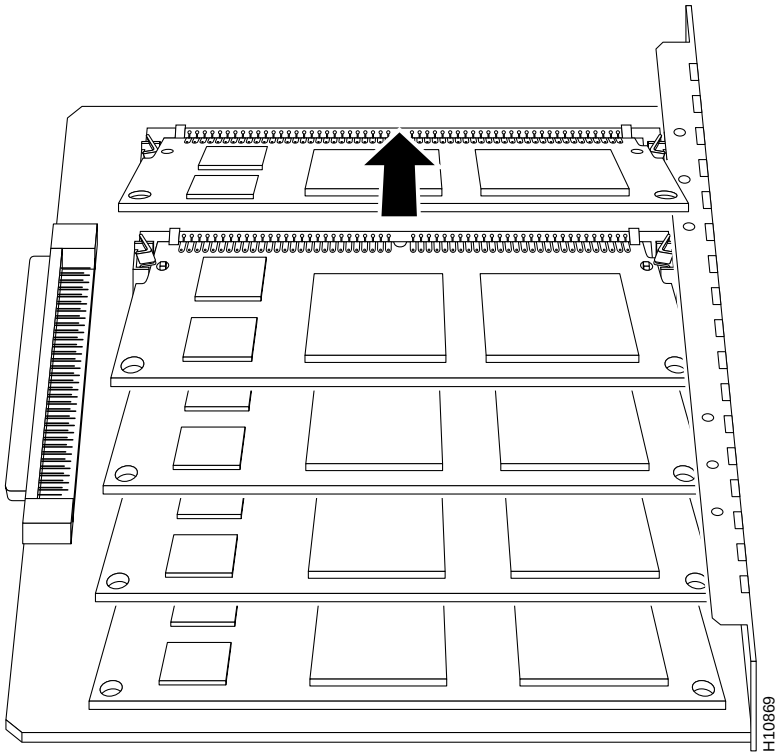
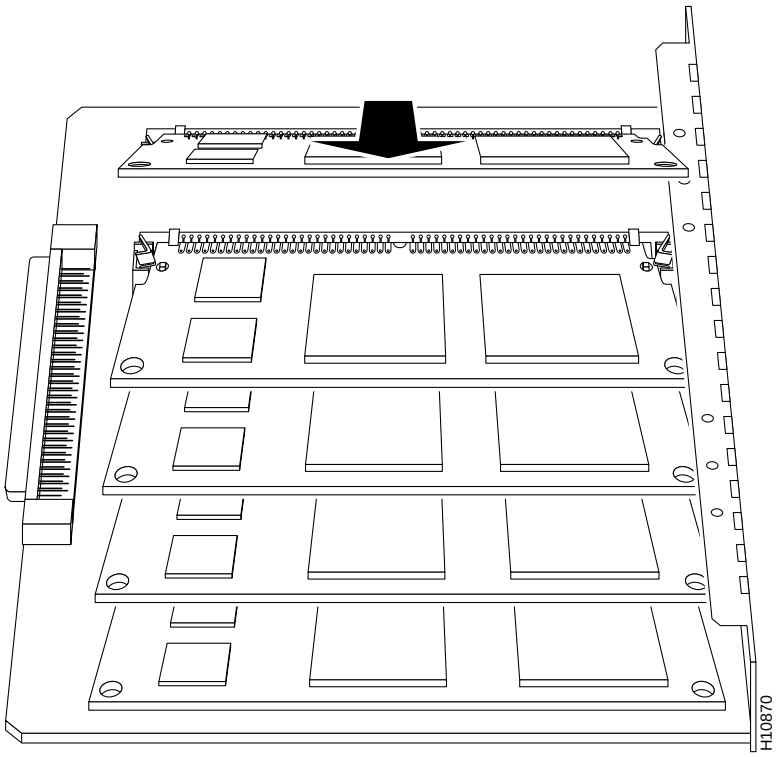


Figure 10-7 Lifting a 6-Port MICA Module Out of the Socket



Installing 6-Port MICA Modules

Follow these steps to install new or replacement MICA modules:

Step 1 Orient the digital modem network module so that the faceplate is on the right.

Caution Handle MICA modules by the card edges only. MICA modules are ESD-sensitive components and can be damaged by mishandling.

Step 2 Hold the MICA module with the connector edge at the bottom and the polarization notch at the right.

Step 3 Tilting the MICA module toward you at about a 45-degree angle, insert it into a socket, beginning with the empty socket closest to you. (See Figure 10-8.) Rock it downward, using the minimum amount of force required. (See Figure 10-9.) When the MICA module is properly seated, the socket guide posts fit through the alignment holes, and the spring clips click into place.

Step 4 Ensure that the MICA module is straight and that the alignment holes line up with the plastic guides on the socket. It is normal to feel some resistance, but do not use excessive force on the MICA module, and do not touch the surface components.

Step 5 Repeat Step 2 through Step 4 for any additional MICA modules.

Figure 10-8 Inserting a 6-Port MICA Module into a Socket

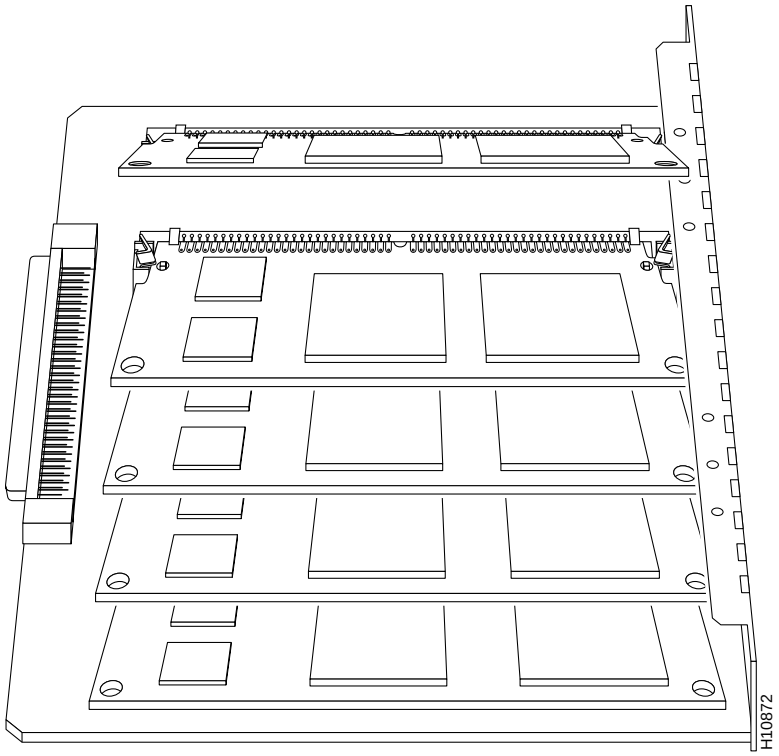
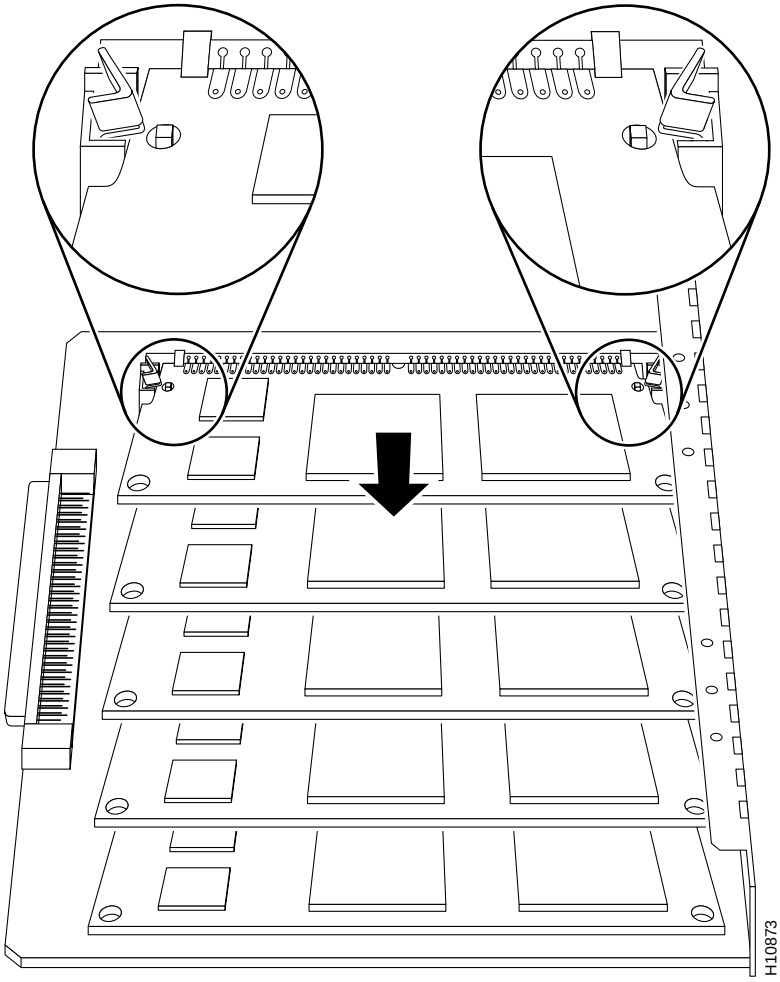


Figure 10-9 Rocking a 6-Port MICA Module Downward



Reinstalling the Digital Modem Network Module

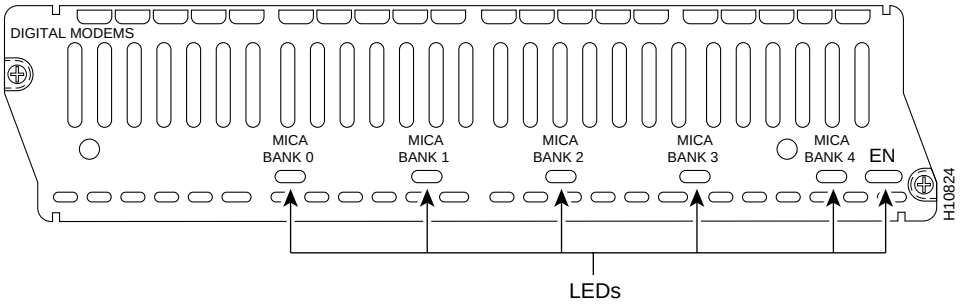
When you finish installing MICA modules, replace the digital modem network module in the router chassis, following the procedure in Chapter 3, “Installing Network Modules in Cisco Modular Routers.”

Digital Modem Module LEDs

All network modules have an enable (EN) LED. (See Figure 10-10.) This LED indicates that the module has passed its self-tests and is available to the router.

Digital modem modules have five additional LEDs, one for each MICA module bank. The LEDs blink during initialization. After the enable LED comes on, the MICA module LEDs indicate that the corresponding MICA module is functioning. If a MICA module fails its diagnostics, or if no MICA module is installed in a position, its LED remains off.

Figure 10-10 Digital Modem Network Module LEDs



CHAPTER 11

Connecting Analog Modem Network Modules to a Network

This chapter contains the following sections:

- 8-Port and 16-Port Analog Modem Network Modules on page 11-1
- Supported Network Protocols on page 11-3
- Interface Numbering on page 11-3
- Connecting the Modules to the Telephone Network on page 11-6
- Analog Modem Network Module LEDs on page 11-7

8-Port and 16-Port Analog Modem Network Modules

The 8-port analog modem network module, Cisco product number NM-8AM= (see Figure 11-1), and the 16-port analog modem network module, Cisco product number NM-16AM= (see Figure 11-2), originate or terminate analog telephone transmissions through RJ-11 modular jacks. They can be used with both Cisco 2600 series and Cisco 3600 series routers. You can connect up to 48 telephone lines by installing three 16-port network modules in a 4-slot Cisco 3640 router, with one LAN network module filling the fourth slot.

Figure 11-1 8-Port Analog Modem Network Module

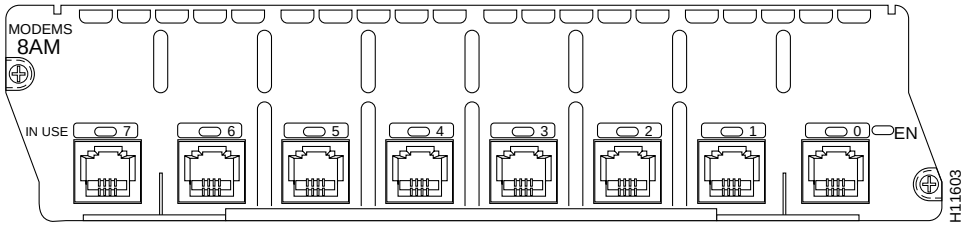
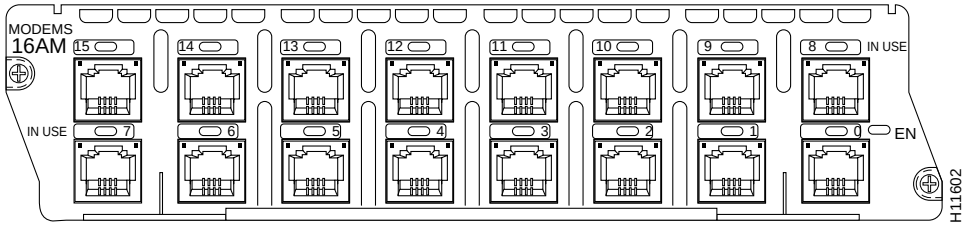


Figure 11-2 16-Port Analog Modem Network Module



The following statement applies in Australia:

Warning This equipment will be inoperable when mains power fails.

The following statement applies in New Zealand:

Warning This equipment does not fully meet Telecom's impedance requirements. Performance limitations may occur when used in conjunction with some parts of the network. Telecom will accept no responsibility should difficulties arise in such circumstances.

Supported Network Protocols

The analog modems described in this chapter support the following protocols:

- All standard data rates from 300 bps to 33.6 kbps (V.34 bis)
- V.42 bis and MNP 5 data compression
- V.42, LAPM, and MNP 2 to 4 error correction
- MNP 10 for high performance under all line conditions
- MNP 10EC for high performance in analog cellular environments

Interface Numbering

Cisco IOS software identifies each modem uniquely by its slot number and a port number.

Some Cisco IOS configuration commands identify asynchronous ports by an interface number (or a line number, which is the same as the interface number). The interface number of a port on an 8-port or 16-port analog modem network module is related to the slot number where the module is installed and the number of the port in the module.

Cisco 3600 series router slot numbers begin at 0 at the bottom right of the chassis, as viewed from the rear. Cisco 3620 router slots are numbered 0 and 1, as shown in Figure 11-3. Cisco 3640 routers have two rows of slots. The bottom row is numbered 0 and 1 and the top row is numbered 2 and 3, as shown in Figure 11-4.

The Cisco 2600 series router's single network module slot is always 1, as shown in Figure 11-5.

Figure 11-3 Cisco 3620 Slot Numbers

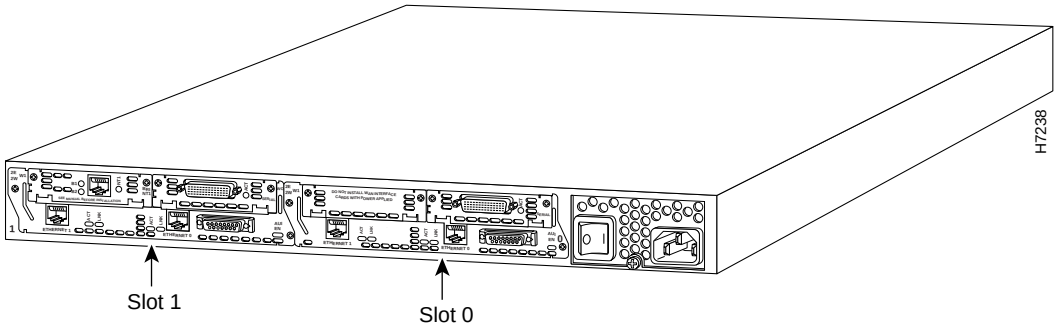


Figure 11-4 Cisco 3640 Slot Numbers

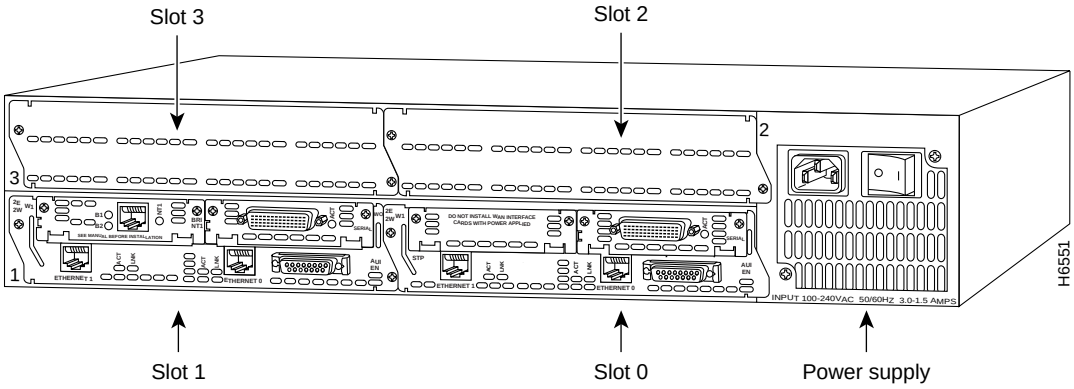
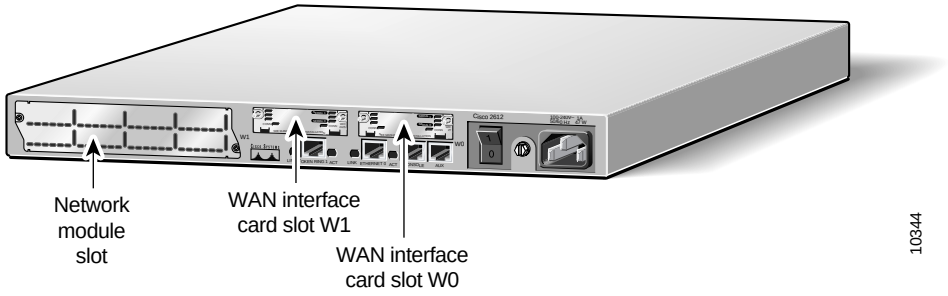


Figure 11-5 Cisco 2600 Slot Numbers



Ports in the 8-port and 16-port analog modem network modules are numbered in the same pattern as slot numbers, beginning at 0 at the lower right and continuing from right to left and (in the 16-port module) from bottom to top.

The interface number of a port is determined in the following way:

interface-number = (32 x *slot-number*) + *port-number* + 1

For example, modem port 12 in slot 1 corresponds to interface number (32 x 1) + 12 + 1 = 45. This is also the line number for the port. Port 12 in slot 1 is always assigned interface number 45, regardless of whether the module in slot 0 is an 8-port analog modem network module, a 16-port analog modem module, or some other kind of module entirely, or even whether there is a network module in slot 0 at all. If you move the module from slot 1 to a different slot, however, its interface numbers change.

Table 11-1 shows the range of interface numbers available for each type of analog modem network module in each router slot. (Interface 0 is automatically assigned to the console.)

Table 11-1 16-Port and 32-Port Analog Module Interface Numbering

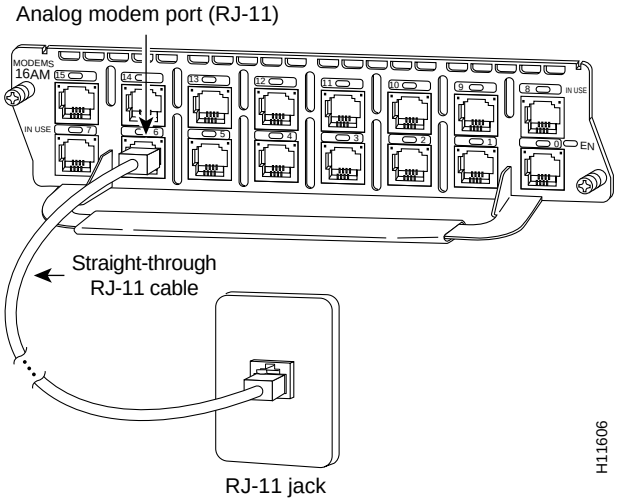
Slot Number	Interface Numbers (8-Port Module)	Interface Numbers (16-Port Module)
0	1 to 8	1 to 16
1	33 to 40	33 to 48
2	65 to 72	65 to 80
3	97 to 104	97 to 112

Connecting the Modules to the Telephone Network

Each analog modem network module provides 8 or 16 RJ-11 jacks for standard modular cables. These ports are color-coded pink. Cables are not provided with the network module.

To establish an analog connection, use a straight-through RJ-11 modular cable to connect the jack to a wall telephone outlet. (See Figure 11-6.)

Figure 11-6 Connecting an Analog Modem Network Module



Analog Modem Network Module LEDs

All network modules have an enable (EN) LED. This LED indicates that the module has passed its self-tests and is available to the router.

Each modem in the module has an in use (IN USE) LED that lights when remote carrier is detected. (See Figure 11-7 and Figure 11-8.)

Figure 11-7 8-Port Analog Modem Network Module LEDs

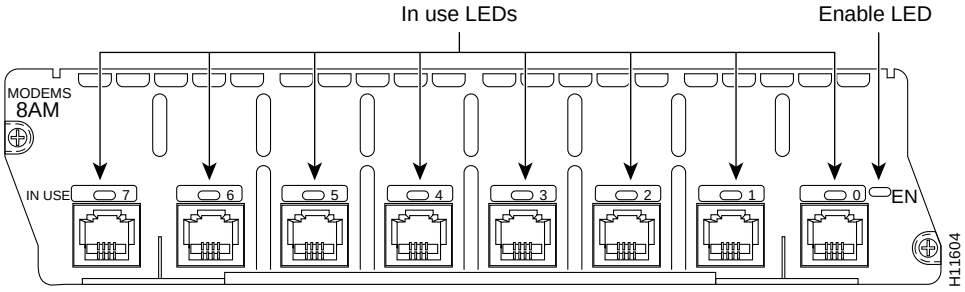
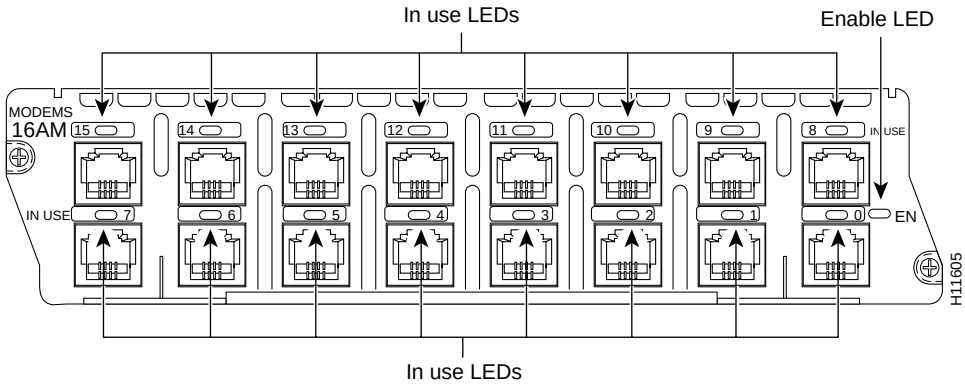


Figure 11-8 16-Port Analog Modem Network Module LEDs



CHAPTER 12

Connecting ATM Network Modules to a Network

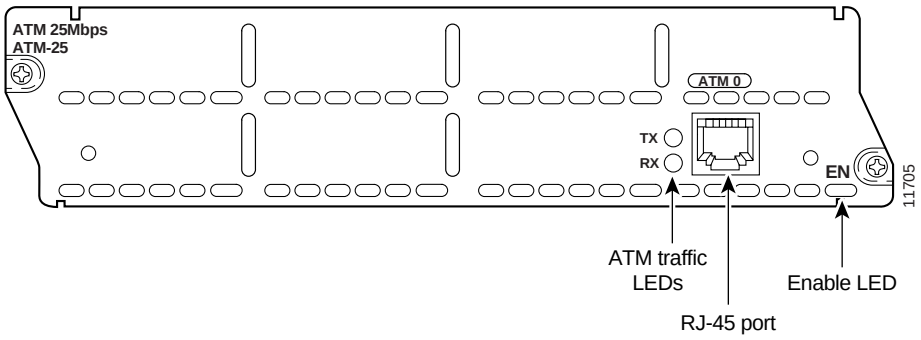
This chapter describes how to connect the 1-port Asynchronous Transfer Mode (ATM-25) network module (Cisco product number NM-1ATM-25) for Cisco modular access routers. It contains the following sections:

- ATM-25 Network Module on page 12-1
- Connecting ATM-25 Ports to the Network on page 12-2
- ATM-25 Network Module LEDs on page 12-4

ATM-25 Network Module

The ATM-25 network module (see Figure 12-1) provides ATM traffic shaping for use with asymmetric digital subscriber line (ADSL) uplink speeds and protocol support for permanent virtual circuit (PVC) environments. The network module provides full support for multiprotocol encapsulation over ATM Adaptive Layer 5 (RFC 1483), classic IP over ATM encapsulation (RFC 1577), and Point-to-Point Protocol (PPP) over ATM.

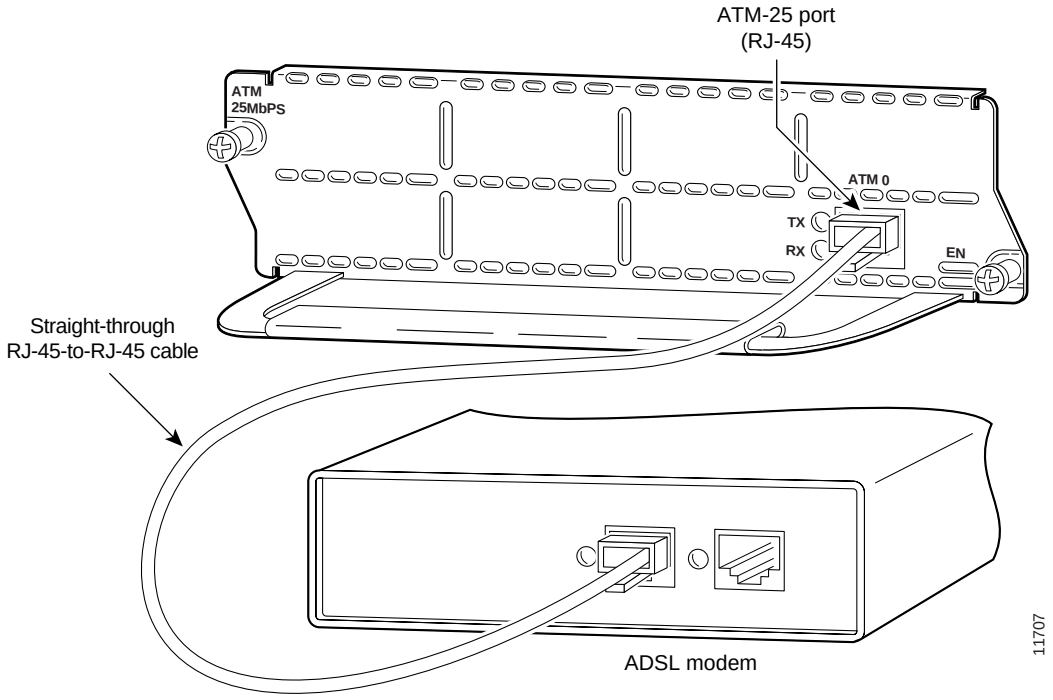
Figure 12-1 ATM-25 Network Module



Connecting ATM-25 Ports to the Network

The ATM-25 port is color-coded light green. The port is a standard RJ-45 jack. Use a straight-through modular RJ-45 UTP Category 3, 4, or 5 cable or STP Category 1, 1A, 9, or 9A cable to connect the port to an external ADSL modem. (See Figure 12-2.)

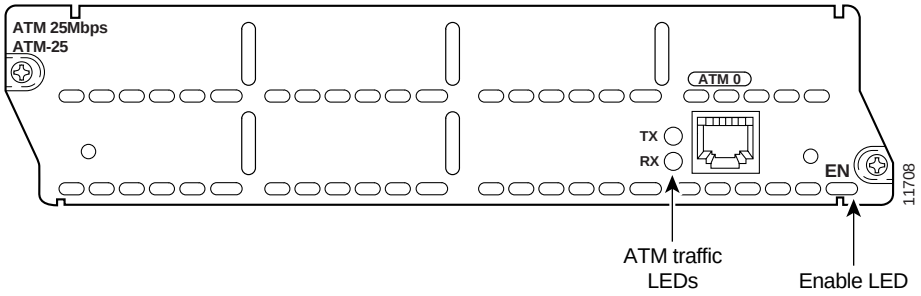
Figure 12-2 Connecting the ATM-25 Module to an ADSL Modem



ATM-25 Network Module LEDs

Figure 12-3 shows ATM-25 network module LEDs.

Figure 12-3 ATM-25 Network Module LEDs



All network modules have an enable (EN) LED. The enable LED indicates that the module has passed its self-tests and is available to the router. The ATM-25 network module has the additional LEDs shown in Table 12-1.

Table 12-1 ATM-25 Network Module LEDs

LED	Meaning
RX	Module is receiving ATM traffic
TX	Module is transmitting ATM traffic

CHAPTER 13

Connecting HSSI Network Modules to a Network

Note High-Speed Serial Interface (HSSI) network modules are supported in Cisco 3600 series routers only.

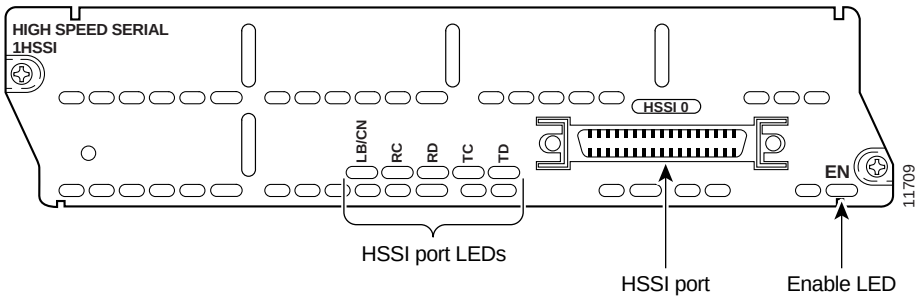
This chapter describes how to connect the 1-port High-Speed Serial Interface (HSSI) network module (Cisco product number NM-1HSSI) for Cisco modular access routers. It contains the following sections:

- HSSI Network Module on page 13-1
- Connecting HSSI Modules to the Network on page 13-2
- HSSI Network Module LEDs on page 13-4

HSSI Network Module

The HSSI network module (see Figure 13-1) is capable of sustaining rates up to T3/E3 speed on Cisco 3600 series routers. A single HSSI port supports Asynchronous Transfer Mode (ATM)/Data Exchange Interface (DXI), Switched Multimegabit Data Service (SMDS), Frame Relay, or High-Level Data Link Control (HDLC) connectivity options. It supports speeds up to 52-Mbps full duplex.

Figure 13-1 HSSI Network Module



Connecting HSSI Modules to the Network

The HSSI module contains a 50-pin receptacle, color-coded blue. You can connect this port to a network in one of two ways:

- To an external data service unit (DSU), using a HSSI data terminal equipment (DTE) cable for operation in DTE mode. (See Figure 13-2.) The HSSI port is configured to operate in this mode by default.
- To another router for back-to-back operation, using a HSSI null modem cable. (See Figure 13-3.) Both routers must be at the same site. Back-to-back operation allows you to verify operation of the HSSI port or link routers directly to build a larger node. Both routers must be configured to use a 51.84-MHz internal clock.

Figure 13-2 Connecting the 1-Port HSSI Module to an External DSU

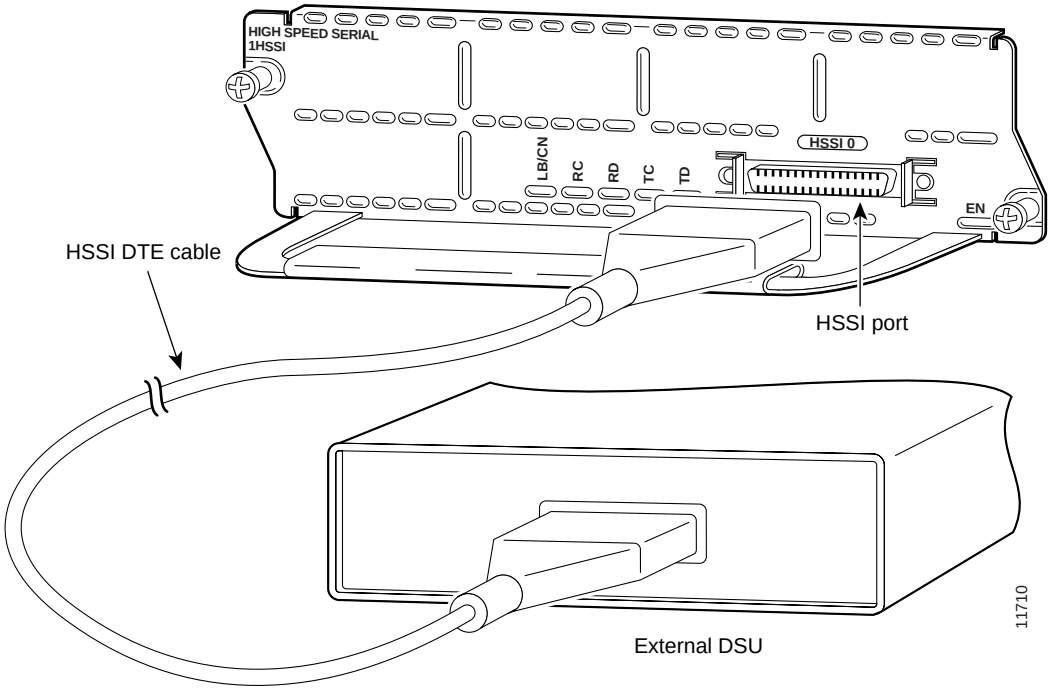
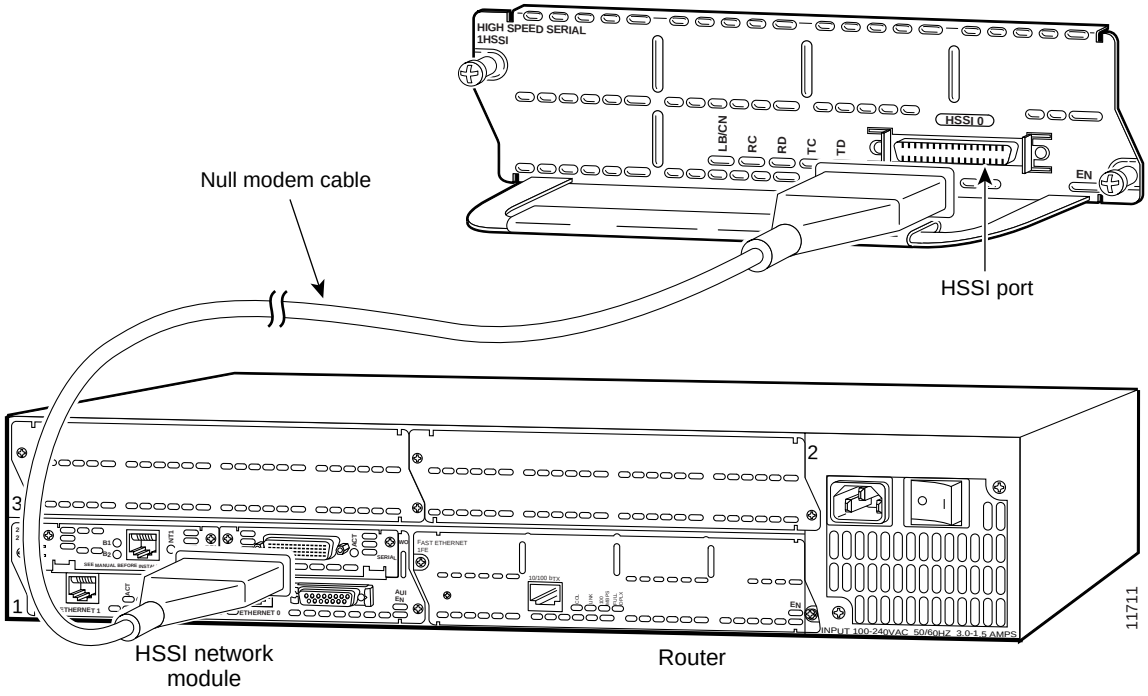


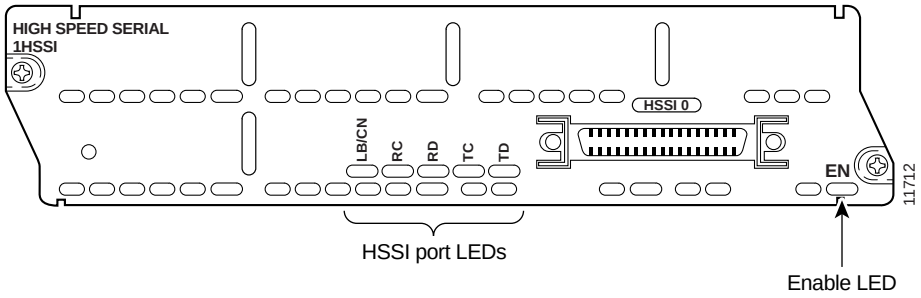
Figure 13-3 Connecting Two Routers Back to Back



HSSI Network Module LEDs

Figure 13-4 shows HSSI network module LEDs.

Figure 13-4 HSSI Network Module LEDs



All network modules have an enable (EN) LED. The enable LED indicates that the module has passed its self-tests and is available to the router. The HSSI network module has the additional LEDs shown in Table 13-1.

Table 13-1 HSSI Network Module LEDs

LED	Meaning
LB/C (Loopback/Connect)	Green indicates normal operation. The module is connected to the external DSU[1], and the signals TA (DTE[2] available) and CA (DCE[3] available) are active. Yellow indicates that the module is in loopback mode. If this LED is off, the port is neither connected to the DSU nor in loopback mode.
RC (Receive Clock)	Module has detected a receive clock signal. During normal operation, this signal is received from the external DSU. During loopback, it is generated internally.
RD (Receive Data)	Module has detected a receive clock signal. During normal operation, this signal is received from the external DSU. During loopback, it is generated internally.
TC (Transmit Clock)	Module is transmitting a clock signal to the external DSU. During normal operation, this signal is derived from the DSU's RT signal. During loopback, it is generated internally.
TD (Transmit Data)	Module has been detected by and can send packets to the external DSU.

1 DSU = data service unit.
2 DTE = data terminal equipment.
3 DCE = data communications equipment.

CHAPTER 14

Connecting Compression Network Modules to a Network

Note Compression network modules are supported in Cisco 3600 series routers only.

This chapter describes the compression network module for Cisco modular routers, and contains the following sections:

- Compression Network Module on page 14-1
- Supported Interfaces on page 14-2
- Compression Network Module LEDs on page 14-3

This module provides hardware assistance to protocols that use compression and decompression, reduces the load on the CPU caused by software compression, and improves router performance.

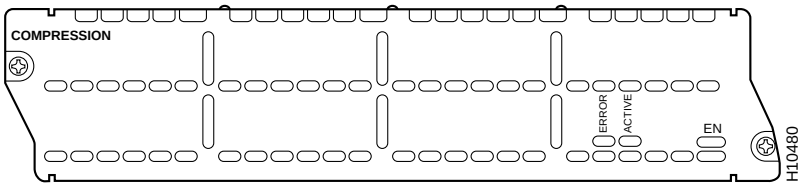
Compression Network Module

The compression network module (Cisco product number NM-COMPR) does not provide network interfaces of its own, but instead compresses and decompresses data passing through interfaces on other network modules or WAN interface cards in the router. (See Figure 14-1.)

Hardware compression is supported only over Point-to-Point Protocol (PPP) links. The compression network module supports only the Stacker compression algorithm.

Cisco IOS Release 11.3 allows Frame Relay compression support using the FRF.9 compression algorithm.

Figure 14-1 Compression Network Module



Supported Interfaces

The compression network module supports the following interfaces:

- Channelized T1 Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI)
- Channelized E1 ISDN PRI
- ISDN Basic Rate Interface (BRI)
- Synchronous serial
- Switched 56-kbps data service unit/channel service unit (DSU/CSU)

Compression Network Module LEDs

Figure 14-2 shows the compression network module LEDs.

Figure 14-2 Compression Network Module LEDs

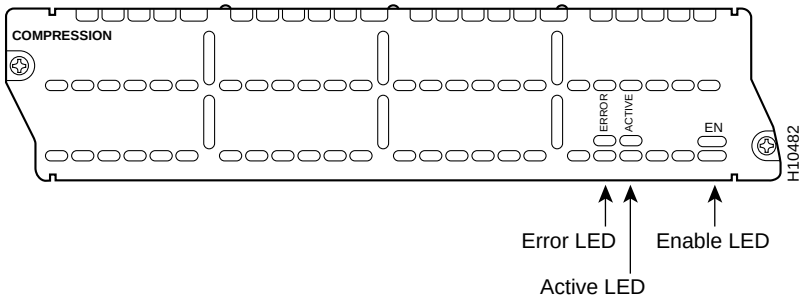


Table 14-1 Compression Network Module LEDs

LED	Meaning
EN (Enable)	Green indicates that the module has passed its self-tests and is available to the router.
ERROR	Amber indicates that an error was found, and if it remains on, that the error might prevent accurate compression. Off during normal operation.
ACTIVE	Green indicates that the module is ready to process data. It goes on when the boot process is complete and stays on during normal operation.

APPENDIX A

FCC Class B Compliance

The equipment described in this document generates and may radiate radio-frequency energy. If it is not installed in accordance with Cisco's installation instructions, it may cause interference with radio and television reception. This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in part 15 of the FCC rules. These specifications are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation.

You can determine whether your equipment is causing interference by turning it OFF. If the interference stops, it was probably caused by the Cisco equipment or one of its peripheral devices. If the equipment causes interference to radio or television reception, try to correct the interference by using one or more of the following measures:

- Turn the television or radio antenna until the interference stops.
- Move the equipment to one side or the other of the television or radio.
- Move the equipment farther away from the television or radio.
- Plug the equipment into an outlet that is on a different circuit from the television or radio. (That is, make certain the equipment and the television or radio are on circuits controlled by different circuit breakers or fuses.)

Modifications to this product not authorized by Cisco Systems, Inc. could void the FCC approval and negate your authority to operate the product.

Note All network modules described in this manual comply with the limits for a Class B digital device in accordance with the specifications in part 15 of the FCC rules. For Telecom and country-specific compliance information, contact Cisco Systems.